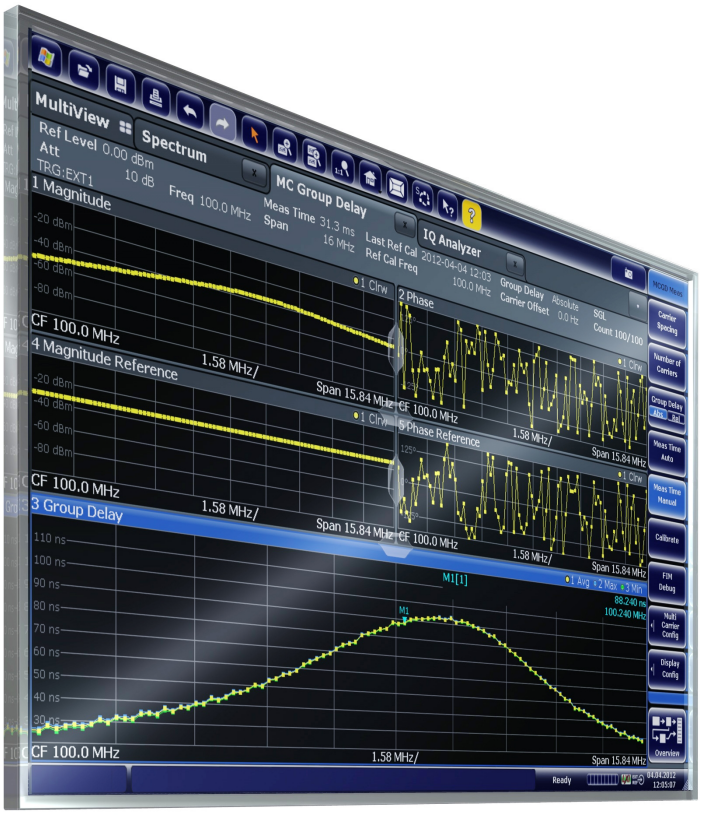
R&S®FSW-K17
Multi-Carrier Group Delay Measurement
User Manual



1173.9405.02 ─ 07

Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®FSW models with firmware version 1.70 and higher:

- R&S®FSW8 (1312.8000K08)
- R&S®FSW13 (1312.8000K13)
- R&S®FSW26 (1312.8000K26)
- R&S®FSW43 (1312.8000K43)
- R&S®FSW50 (1312.8000K50)

The following firmware options are described:

- R&S FSW-K17 (1313.4150.02)

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

© 2013 Rohde & Schwarz GmbH & Co. KG
Mühldorfstr. 15, 81671 München, Germany
Phone: +49 89 41 29 - 0
Fax: +49 89 41 29 12 164
E-mail: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com
Printed in Germany – Subject to change – Data without tolerance limits is not binding.
R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.
Trade names are trademarks of the owners.

The following abbreviations are used throughout this manual: R&S®FSW is abbreviated as R&S FSW.

Contents

1 Preface....5
1.1 About this Manual....5
1.2 Documentation Overview....6
1.3 Conventions Used in the Documentation....7
2 Welcome to the Multi-Carrier Group Delay Application....9
2.1 Starting the Multi-Carrier Group Delay Application....9
2.2 Understanding the Display Information....10
3 About the Measurement....13
4 Measurements and Result Display....15
4.1 Evaluation Methods for Multi-Carrier Group Delay....15
5 Measurement Basics....20
5.1 Definitions....20
5.2 The Multi-Carrier Measurement....20
5.3 The Calibration (Reference) Measurement....22
5.4 Measurement Setup....22
6 Configuration....24
6.1 Default Settings for Multi-Carrier Group Delay measurements....24
6.2 Configuration Overview....25
6.3 Input Source Settings....27
6.4 Amplitude and Y-Axis Scaling....29
6.5 Frequency Settings....36
6.6 Trigger Settings....38
6.7 Multi-Carrier Configuration....43
6.8 Sweep Settings....48
6.9 Output Settings....49
6.10 Automatic Settings....51
7 Analysis....54
7.1 Trace Settings....54
7.2 Trace Export Settings....57

7.3 Markers....58
7.4 Display Configuration....66
7.5 Zoom Functions....66

8 Importing and Exporting Results....68
8.1 Export Functions....68
8.2 Import Functions....69

9 How to Perform Measurements in the Multi-Carrier Group Delay Application....70

10 Optimizing and Troubleshooting the Measurement....73
10.1 Error and Status Messages....74

11 Remote Commands to Perform Multi-Carrier Group Delay Measurements....75
11.1 Introduction....75
11.2 Common Suffixes....80
11.3 Activating Multi-Carrier Group Delay Measurements....80
11.4 Configuring Multi-Carrier Group Delay Measurements....84
11.5 Measuring, Loading and Storing Calibration Data....108
11.6 Configuring the Result Display....109
11.7 Configuring and Performing Sweeps....116
11.8 Retrieving Results....122
11.9 Analyzing Multi-Carrier Group Delay Measurements....127
11.10 Commands for Compatibility....141

12 Annex....147
12.1 Formats for Returned Values: ASCII Format and Binary Format....147
12.2 Reference: ASCII File Export Format....147
12.3 Reference: CSV File Export Format....149

List of Remote Commands (MC Group Delay)....152

Index....156

1 Preface

1.1 About this Manual

This Multi-Carrier Group Delay User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S FSW User Manual.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- **Welcome to the Multi-Carrier Group Delay Application**
  Introduction to and getting familiar with the application
- **About the measurement**
  General concept of the MCGD measurement and typical applications
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **How to Perform Measurements in the Multi-Carrier Group Delay Application**
  Step-by-step instructions to perform a basic MCGD measurement
- **Measurement Examples**
  Detailed measurement examples to guide you through typical measurement scenarios and allow you to try out the application immediately
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the test setup
- **Remote Commands for Multi-Carrier Group Delay Measurements**
  Remote commands required to configure and perform Multi-Carrier Group Delay measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S FSW User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Annex**
  Reference material
- **List of remote commands**
  Alpahabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation Overview

The user documentation for the R&S FSW consists of the following parts:

- "Getting Started" printed manual
- Online Help system on the instrument
- Documentation CD-ROM with:
  - Getting Started
  - User Manuals for base unit and options
  - Service Manual
  - Release Notes
  - Data sheet and product brochures

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. Online help is available using the icon on the toolbar of the R&S FSW.

Getting Started

This manual is delivered with the instrument in printed form and in PDF format on the CD. It provides the information needed to set up and start working with the instrument. Basic operations and handling are described. Safety information is also included.

The Getting Started manual in various languages is also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html.

User Manuals

User manuals are provided for the base unit and each additional (software) option.

The user manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the user manuals, all instrument functions are described in detail. Furthermore, they provide a complete description of the remote control commands with programming examples.

The user manual for the base unit provides basic information on operating the R&S FSW in general, and the Spectrum application in particular. Furthermore, the software functions that enhance the basic functionality for various applications are described here. An introduction to remote control is provided, as well as information on maintenance, instrument interfaces and troubleshooting.

In the individual application manuals, the specific instrument functions of the application are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S FSW is not included in the application manuals.

All user manuals are also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html.

Service Manual

This manual is available in PDF format on the CD delivered with the instrument. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S FSW by replacing modules.

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes.

The most recent release notes are also available for download from the R&S website, on the R&S FSW product page at http://www2.rohde-schwarz.com/product/FSW.html > Downloads > Firmware.

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

2 Welcome to the Multi-Carrier Group Delay Application

The R&S FSW-K17 option is a firmware application that adds functionality to perform Multi-Carrier Group Delay measurements to the R&S FSW.

The Multi-Carrier Group Delay application features:

- highly accurate group delay measurement for large spans
- orthogonal measurement method
- frequency converted group delay measurement
- storage and loading functions for reference data
- storage functions for measurement settings and results
- graphical display of:
  - group delay
  - magnitude and phase at carrier frequency points in measurement or reference signal
- interactive or remote measurement control

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S FSW User Manual. The latest version is available for download at the product homepage.

Installation

You can find detailed installation instructions in the R&S FSW Getting Started manual or in the Release Notes.

2.1 Starting the Multi-Carrier Group Delay Application

The Multi-Carrier Group Delay application adds a new measurement to the R&S FSW.

To activate the Multi-Carrier Group Delay application

1. Press the MODE key on the front panel of the R&S FSW.

   A dialog box opens that contains all operating modes and applications currently available on your R&S FSW.

2. Select the "MC Group Delay" item.

The R&S FSW opens a new measurement channel for the Multi-Carrier Group Delay application.

The measurement is started immediately with the default settings. It can be configured in the Multi-Carrier Group Delay "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu (see chapter 6.2, "Configuration Overview", on page 25).

Multiple Measurement Channels and Sequencer Function

When you activate an application, a new measurement channel is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channels for the same application.

The number of channels that can be configured at the same time depends on the available memory on the instrument.

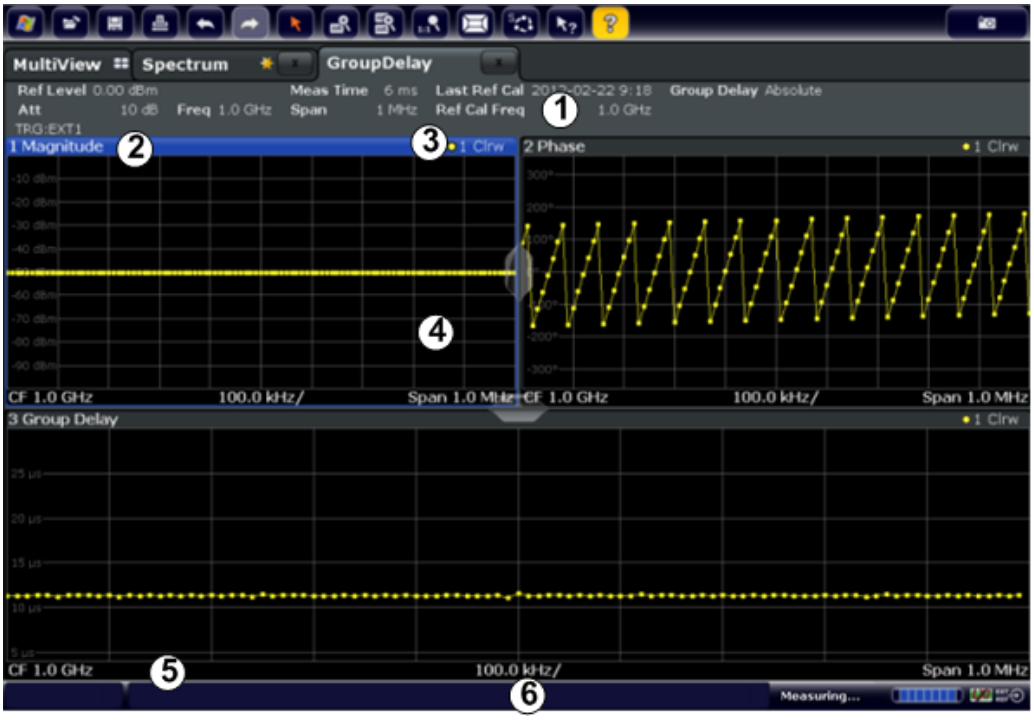
Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.

If activated, the measurements configured in the currently active channels are performed one after the other in the order of the tabs. The currently active measurement is indicated by a symbol in the tab label. The result displays of the individual channels are updated in the tabs (including the "MultiView") as the measurements are performed. Sequential operation itself is independant of the currently *displayed* tab.

For details on the Sequencer function see the R&S FSW User Manual.

2.2 Understanding the Display Information

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.



1 = Channel bar for firmware and measurement settings
2+3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information, depending on evaluation
6 = Instrument status bar with error messages, progress bar and date/time display

Channel bar information

In the Multi-Carrier Group Delay application, the R&S FSW shows the following settings:

Table 2-1: Information displayed in the channel bar in the Multi-Carrier Group Delay application

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Offset	Reference level offset
Freq	Center frequency for the RF signal
Meas Time	Measurement time
Span	Measurement bandwidth
Last Ref Cal	Timestamp of most recently performed reference calibration (if it has already been performed)
Ref Cal Freq	Frequency used for reference calibration
Group Delay	Mode of group delay result display (absolute or relative)
Carrier Offset	Offset of the carrier from the center frequency

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed

only when applicable for the current measurement. For details see the R&S FSW Getting Started manual.

Window title bar information

For each diagram, the header provides the following information:

Fig. 2-1: Window title bar information in Multi-Carrier Group Delay application

1 = Window number
2 = Window type
3 = Trace color
4 = Trace number
5 = Trace mode

Diagram footer information

The diagram footer (beneath the diagram) contains the center frequency and span and the range displayed per division.

Status bar information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram. Furthermore, the progress of the current operation is displayed in the status bar.

3 About the Measurement

Frequency delay in transmitted signals

All frequency components of a signal are delayed when passed through a device such as an amplifier, a loudspeaker, or propagated through space or a medium, such as air. This signal delay will be different for the various frequencies unless the device has the property of being linear phase. The delay variation means that signals consisting of multiple frequency components will suffer distortion because these components are not delayed by the same amount of time at the output of the device. This changes the shape of the signal in addition to any constant delay, which can result in a signal that no longer matches the receiver filter, which in turn results in degraded Signal to Noise Ratio (SNR) or Bit Error Rate (BER).

Group delay as a characterization of transmission components

The delay of all frequencies together is referred to as the group delay and can be used to characterize the quality of transmission for such components. Group delay is also a measure of how long it takes for a signal's information to propagate through a channel or device under test.

Since digital modulation schemes in which the frequency plays an important role are very common, the group delay is of special interest to all manufacturers or testers of transmission components, as well as frequency converters. Satellite transponders, for example, need to be characterized by the phase transmission in addition to the amplitude transmission. Both values can be determined precisely and easily with the R&S FSW Multi-Carrier Group Delay application.

The Multi-Carrier Group Delay measurement method

The R&S FSW Multi-Carrier Group Delay application evaluates an input signal provided by a signal generator. After a preliminary reference measurement of this signal without the device under test, the same signal is evaluated with the device subsequently. Instead of evaluating the timing of the signals, the phase shift and magnitude response of multiple carriers across frequency is measured. A baseband signal consisting of several unmodulated carriers with a fixed step size is used as an input signal, allowing for a very quick wideband measurement. By measuring the phase differences between the two signals at the input and at the output, the application calculates the relative phase between output and input.

However, the phase of the carriers at the input to the DUT does not actually have to be measured. Instead, the results are normalized. That way, no reference path or connection is needed between the input and the output of the DUT. A reference mixer in the signal generator provides a phase reference at the IF frequency. Thus, a constant delay factor is eliminated and the group delay is calculated relative to the reference signal.

If an external trigger is used, the absolute group delay can also be calculated. Absolute group delay is of interest for instance to equalize the delay of two channels, characterize cables and design quadrature FM demodulators.

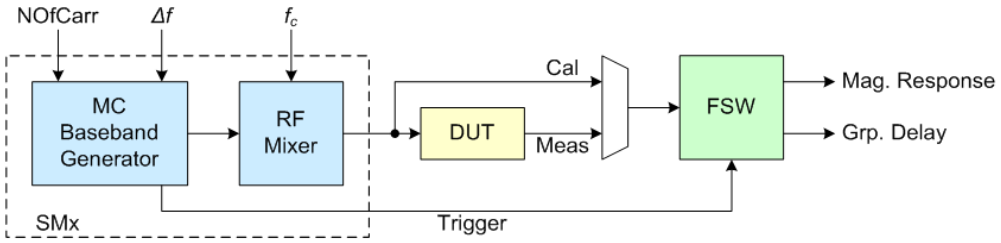


Fig. 3-1: Multi-Carrier Group Delay Measurement Setup

4 Measurements and Result Display

The data that was measured by the R&S FSW can be evaluated using various different methods. In the Multi-Carrier Group Delay application, up to 6 evaluation methods can be displayed simultaneously in separate windows.

All results are determined from the I/Q data set captured for the measurement.

Storing Results

The results of the Multi-Carrier Group Delay measurement can be stored to a file, either in CSV or ASCII format. The results of the calibration (reference) measurement can also be stored in CSV format.

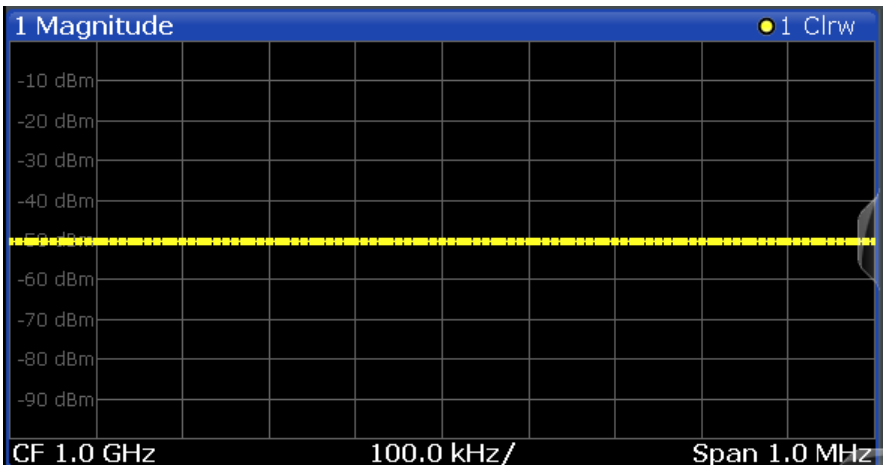
- Evaluation Methods for Multi-Carrier Group Delay.....15

4.1 Evaluation Methods for Multi-Carrier Group Delay

The following evaluation methods can be selected for Multi-Carrier Group Delay measurements.

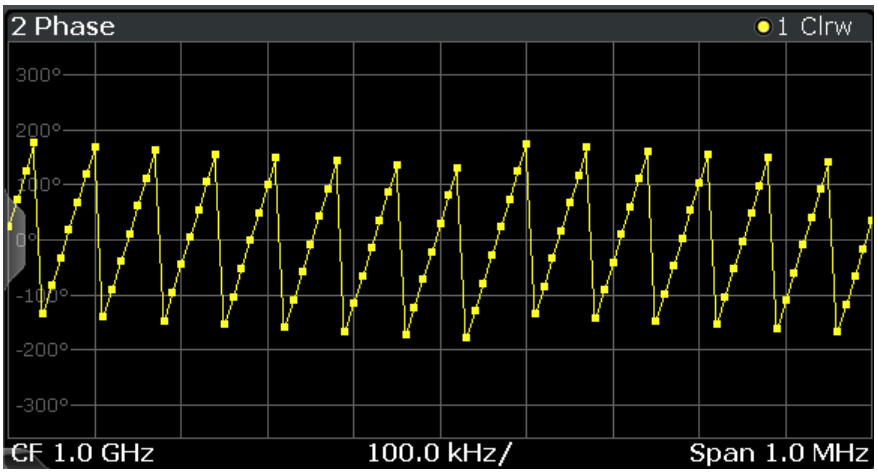
Magnitude.....15
Phase.....16
Magnitude Reference.....16
Phase Reference.....17
Group Delay.....17
Gain.....18
Marker Table.....18

Magnitude
Displays the spectrum of the input signal. In contrast to the Spectrum application, the frequency values are determined using an *Discrete frequency transformation* (DFT) from the recorded I/Q data set.



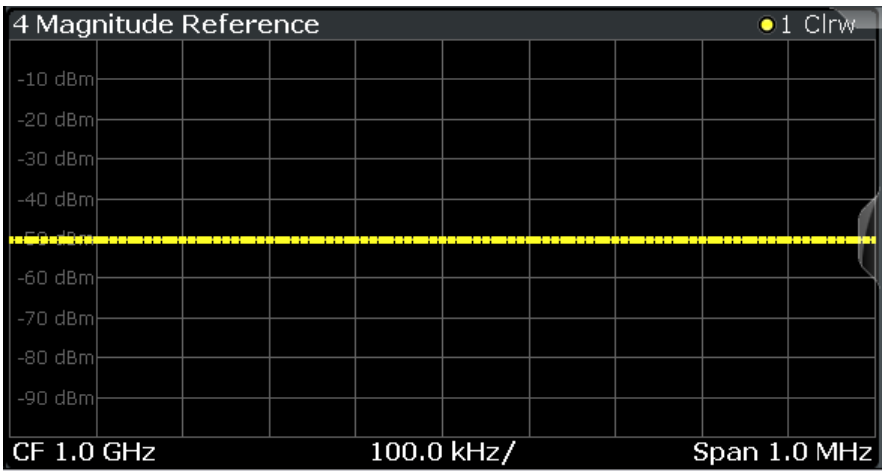
Remote command:
`LAY:ADD? '1',RIGH,MAGN`
(see `LAYout:ADD[:WINDow]?` on page 111)

Phase
Displays the phase deviations of the measured signal (in rad or °) versus frequency.



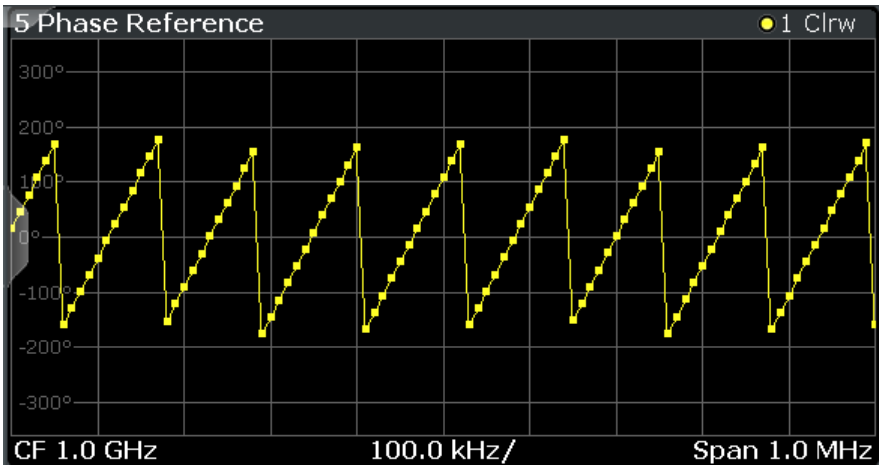
Remote command:
`LAY:ADD? '1',RIGH,PHAS`
(see `LAYout:ADD[:WINDow]?` on page 111)

Magnitude Reference
Displays the spectrum of the reference signal. In contrast to the Spectrum application, the frequency values are determined using DFT from the recorded I/Q data set.



Remote command:
`LAY:ADD? '1',RIGH,RMAG`
(see `LAYout:ADD[:WINDow]?` on page 111)

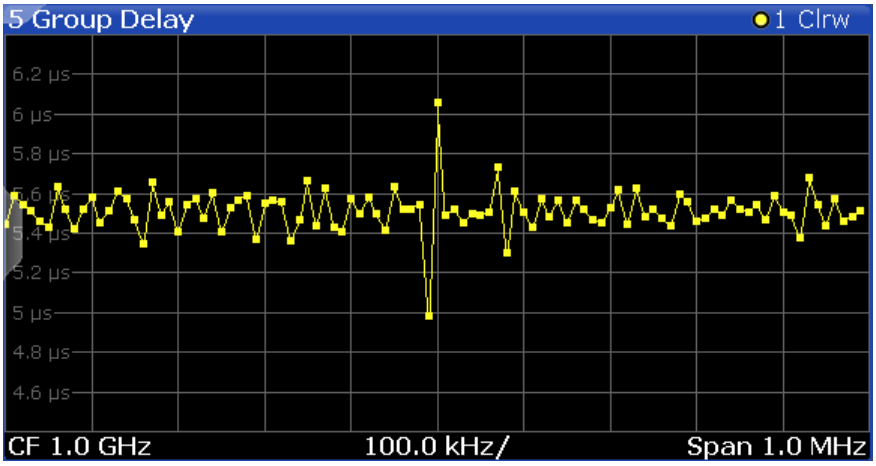
Phase Reference
Displays the phase deviations of the reference signal (in rad or °) versus frequency.



Remote command:
`LAY:ADD? '1',RIGH,RPH`
(see `LAYout:ADD[:WINDow]?` on page 111)

Group Delay
Displays the time deviations of the signal versus frequency.

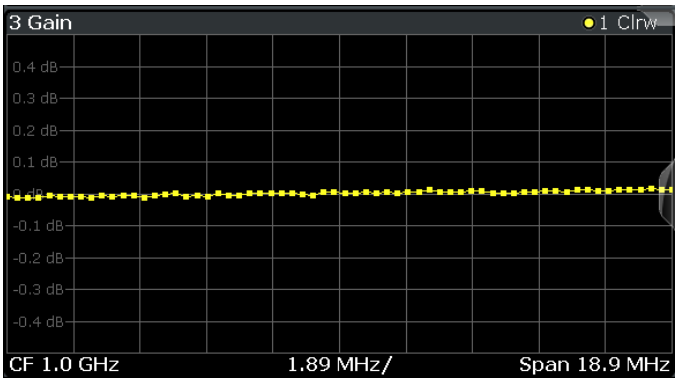
Note: This result display requires a calibration measurement (see "Calibrate (Execute Reference Calibration)" on page 47).



Remote command:
`LAY:ADD? '1',RIGH,GRPD`
(see `LAYout:ADD[:WINDow]?` on page 111)

Gain
Displays the gain in magnitude from the reference trace to the measurement trace in dB or percent. This diagram characterizes the transmission behavior of the DUT.

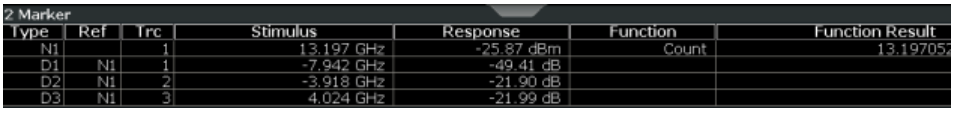
Note: This result display requires a calibration measurement (see "Calibrate (Execute Reference Calibration)" on page 47).



Remote command:
`LAY:ADD? '1',RIGH,GAIN`
(see `LAYout:ADD[:WINDow]?` on page 111)

Marker Table
Displays a table with the current marker values for the active markers.

This table may be displayed automatically if configured accordingly (see "Marker Table Display" on page 62).


2 Marker
Type Ref Trc Stimulus Response Function Function Result
N1 1 13.197 GHz -25.87 dBm Count 13.19705
D1 N1 1 -7.942 GHz -49.41 dB
D2 N1 2 -3.918 GHz -21.90 dB
D3 N1 3 4.024 GHz -21.99 dB

Remote command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 111

Results:

`CALCulate<n>:MARKer<m>:X` on page 134

`CALCulate<n>:MARKer<m>:Y?` on page 123

5 Measurement Basics

Some background knowledge on basic terms and principles used in Multi-Carrier Group Delay measurements is provided here for a better understanding of the required configuration settings.

5.1 Definitions

Group delay

Group delay is a measure of phase distortion and defined as the derivation of phase over frequency:

$$\tau(f) = -\frac{1}{2\pi} \cdot \frac{d\varphi_{delta}(f)}{df} \quad with \quad \varphi_{delta}(f) = \mathrm{unwrap}\left(\varphi_{meas}(f) - \varphi_{cal}(f)\right)$$

Gain (Magnitude flatness)

The *gain* (also referred to as the magnitude flatness or amplitude flatness) is defined as the relation between the measured magnitude and the reference (calibration) magnitude:

$$\boldsymbol{Gain(f) = \frac{M_{meas}(f)}{M_{cal}(f)}}$$

The gain describes the transmission behavior of the DUT.

5.2 The Multi-Carrier Measurement

The R&S FSW Multi-Carrier Group Delay application evaluates an input signal provided by a signal generator. A signal consisting of several unmodulated carriers with a fixed step size is used as an input signal.

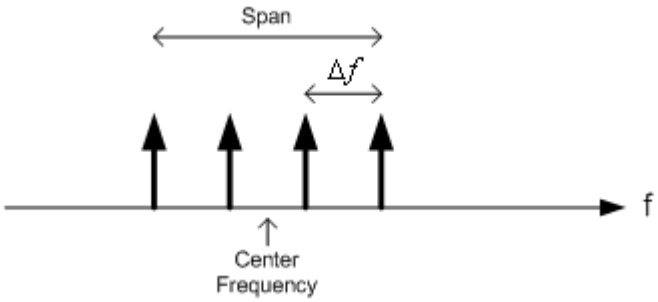
Span

The frequency **span** to be swept during the measurement is determined by the number of carriers in the input signal and the spacing between them. It is recommended that you set the span according to the following equation:

*Span = (Number of carriers -1) * carrier spacing (Δf)*

Example:

A span ≥ 3 * carrier spacing (Δf) is required to measure a signal with four carriers.



As a rule, the span can only be defined as a multiple of the carrier spacing.

Center frequency and carrier offset

If the carriers are not aligned with the defined center frequency, the offset can be determined automatically or, set to a fixed value (depending on the number of carriers) to enhance the result display.

Demodulation bandwidth

The bandwidth to be demodulated during the measurement is determined automatically by the application from the defined span and carrier spacing.

Measurement time

The required duration of the measurement can be determined automatically by the application according to the defined carrier spacing and span, or it can be configured manually.

Averaging results

The calculated values can be averaged over several sweeps in order to obtain more reliable results.

Orthogonal calculation method

The orthogonal calculation method aligns the trace points in the result display to the carrier frequencies of the input signal. To do so, a DFT window length equaling 1/Δf is used.

Absolute vs relative group delay

The group delay is calculated relative to the reference signal, eliminating any constant delay factors. If an external trigger is used, the absolute group delay can also be calculated.

5.3 The Calibration (Reference) Measurement

The Multi-Carrier Group Delay measurement method requires a preliminary reference measurement of the input signal *without the device under test* before the actual group delay measurement. This reference measurement is also referred to as the **calibration measurement**. The results of this measurement are stored internally in the R&S FSW to be used as a reference for the group delay calculation in the subsequent measurement *with* the DUT.

The results of the calibration measurement can be stored to a file and loaded as reference data for future measurements with the same setup.

The date and time of the most recently performed or loaded calibration measurement is indicated in the channel bar.

5.4 Measurement Setup

Before a Multi-Carrier Group Delay measurement can be performed, the R&S FSW must be set up in a test environment. This section describes the required settings of the R&S FSW. Before starting the measurements, the R&S FSW has to be configured correctly and supplied with power as described in the R&S FSW Getting Started manual, "Preparing For Use". Furthermore, the application firmware R&S FSW-K17 must be enabled. Installation and enabling of the application firmware are described in the R&S FSW Getting Started manual or in the Release Notes.

A Multi-Carrier Group Delay measurement requires the following devices:

- A baseband signal generator, e.g. a Vector Signal Generator R&S SMU
- The R&S FSW with application firmware R&S FSW-K17: Multi-Carrier Group Delay
- The device under test to be analyzed

► Connect the signal generator output to the RF INPUT connector of the R&S FSW - first without the DUT, then with the DUT inbetween.

For absolute group delay measurement, connect the trigger output of the signal generator to one of the trigger inputs (TRIGGER INPUT) of the R&S FSW (see "Trigger 2/3" on page 42).

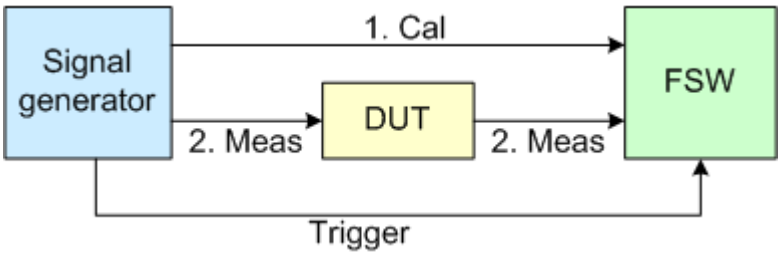


Fig. 5-1: Multi-Carrier Group Delay test setup

It is recommended that you use an input signal with a low crest factor to get the phase response of the DUT. Furthermore, an external frequency reference is recommended for high accuracy measurements.

The following list summarizes the necessary measurement and calculation steps:

1. Calibration measurement without DUT:
   $\varphi_{cal}(k)$
2. Measurement with DUT:
   $\varphi_{meas}(k)$
3. Evaluate group delay:

$$\tau(f) = -\frac{1}{2\pi} \cdot \frac{d\varphi_{delta}(f)}{df} \quad with \quad \varphi_{delta}(f) = \mathrm{unwrap}\left(\varphi_{meas}(f) - \varphi_{cal}(f)\right)$$

6 Configuration

Multi-Carrier Group Delay Application

Multi-Carrier Group Delay measurements require a special application on the R&S FSW, which you activate using the MODE key on the front panel.

When you switch the application of a measurement channel to Multi-Carrier Group Delay application the first time, a set of parameters is passed on from the currently active application (see chapter 6.1, "Default Settings for Multi-Carrier Group Delay measurements", on page 24). After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

When you activate a measurement channel in Multi-Carrier Group Delay application, a Multi-Carrier Group Delay measurement for the input signal is started automatically with the default configuration. The "MCGD Meas" menu is displayed and provides access to the most important configuration functions.

- Default Settings for Multi-Carrier Group Delay measurements....24
- Configuration Overview....25
- Input Source Settings....27
- Amplitude and Y-Axis Scaling....29
- Frequency Settings....36
- Trigger Settings....38
- Multi-Carrier Configuration....43
- Sweep Settings....48
- Output Settings....49
- Automatic Settings....51

6.1 Default Settings for Multi-Carrier Group Delay measurements

When you switch the application of a measurement channel to Multi-Carrier Group Delay application the first time, a set of parameters is passed on from the currently active application:

- center frequency and center frequency offset
- reference level and reference level offset
- attenuation

After initial setup, the parameters for the measurement channel are stored upon exiting and restored upon re-entering the channel. Thus, you can switch between applications quickly and easily.

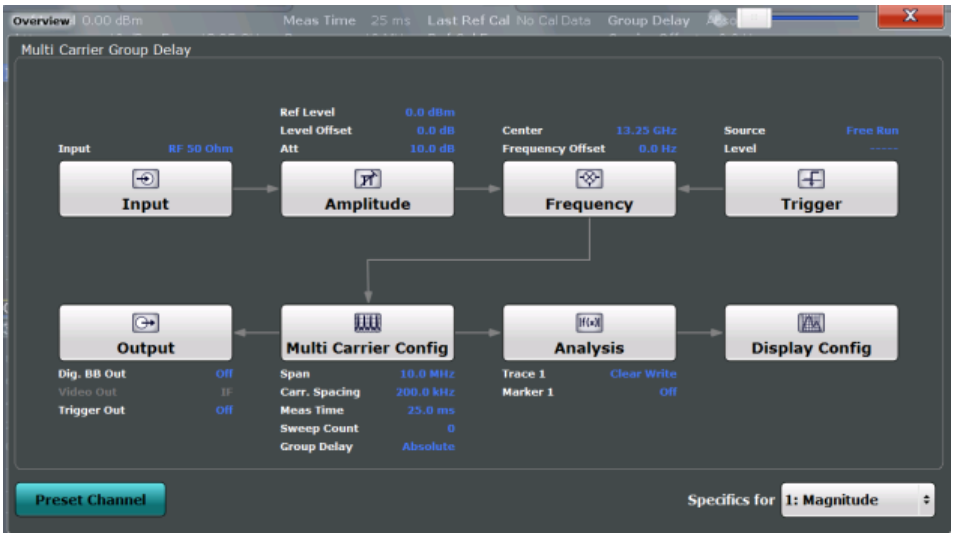
Apart from these settings, the following default settings are activated directly after a measurement channel has been set to Multi-Carrier Group Delay application, or after a Preset Channel:

Table 6-1: Default settings for Multi-Carrier Group Delay channels

Parameter	Value
Span	10.0 MHz
Sweep mode	CONTINUOUS
Trigger settings	FREE RUN
Trigger offset	0
Carrier Spacing	200 kHz
Measurement time	25 ms (manual)
Sweep count	0
Group Delay mode	absolute
Traces	1: Clr/Write, 2-4: blank
Evaluations	Window 1: Magnitude Window 2: Phase Window 3: Group Delay

6.2 Configuration Overview

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" icon, which is available at the bottom of all softkey menus.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Input Settings
   See chapter 6.3, "Input Source Settings", on page 27
2. Amplitude Settings
   See chapter 6.4, "Amplitude and Y-Axis Scaling", on page 29
3. Frequency Settings
   See chapter 6.5, "Frequency Settings", on page 36
4. Trigger Settings
   See chapter 6.6, "Trigger Settings", on page 38
5. Multi-Carrier Configuration
   See chapter 6.7, "Multi-Carrier Configuration", on page 43
6. Output Settings
   See chapter 6.9, "Output Settings", on page 49
7. Analysis
   See chapter 7, "Analysis", on page 54
8. Display Configuration
   See chapter 7.4, "Display Configuration", on page 66

The main configuration settings and dialog boxes are also available via the "MCGD Meas" menu which is displayed when you press the MEAS CONFIG key.

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

For step-by-step instructions on configuring Multi-Carrier Group Delay measurements, see chapter 9, "How to Perform Measurements in the Multi-Carrier Group Delay Application", on page 70.

Preset Channel
Select the "Preset Channel" button in the lower lefthand corner of the "Overview" to restore all measurement settings **in the current channel** to their default values.

Note that the PRESET key on the front panel restores all measurements **in all measurement channels** on the R&S FSW to their default values!

See chapter 6.1, "Default Settings for Multi-Carrier Group Delay measurements", on page 24 for details.

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 84

Specifics for
The measurement channel may contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specifics for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

6.3 Input Source Settings

The input source determines which data the R&S FSW will analyze.

Input settings can be configured via the INPUT/OUTPUT key, in the "Input" dialog box.

Some settings are also available in the "Amplitude" tab of the "Amplitude" dialog box.

The Digital IQ input source is only available in applications that support I/Q data processing and is described in detail in the R&S FSW I/Q Analyzer User Manual.

- Radio Frequency Input....27

6.3.1 Radio Frequency Input

The default input source for the R&S FSW is "Radio Frequency", i.e. the signal at the RF INPUT connector on the front panel of the R&S FSW. If no additional options are installed, this is the only available input source.

Input Coupling....28
Impedance....28
High-Pass Filter 1...3 GHz....28
YIG-Preselector....28

Input Coupling
The RF input of the R&S FSW can be coupled by alternating current (AC) or direct current (DC).

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the data sheet.

Remote command:
`INPut:COUPling` on page 85

Impedance
The reference impedance for the measured levels of the R&S FSW can be set to 50 Ω or 75 Ω.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Remote command:
`INPut:IMPedance` on page 86

High-Pass Filter 1...3 GHz
Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires option R&S FSW-B13.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG filter.)

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 85

YIG-Preselector
Activates or deactivates the YIG-preselector.

An internal YIG-preselector at the input of the R&S FSW ensures that image frequencies are rejected. However, this is only possible for a restricted bandwidth. In order to use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the R&S FSW, which may lead to image-frequency display.

Note that the YIG-preselector is active only on frequencies greater than 8 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

Note:
For the following measurements, the YIG-Preselector is off by default (if available).
- I/Q Analyzer (and thus in all applications in MSRA operating mode)
- Multi-Carrier Group Delay
- GSM
- VSA

INPut:FILTer:YIG[:STATe] on page 85

6.4 Amplitude and Y-Axis Scaling

The amplitude and y-axis scaling are configured in the "Amplitude" dialog box. Amplitude settings are identical to the base unit.

For background information on amplitude settings see the R&S FSW User Manual.

► To display this dialog box, do one of the following:

- Select the "Amplitude" button in the "Overview".
- Select the AMPT key and then the "Amplitude Config" softkey.

- Amplitude Settings....29
- Scaling the Y-Axis....32
- Units....35

6.4.1 Amplitude Settings

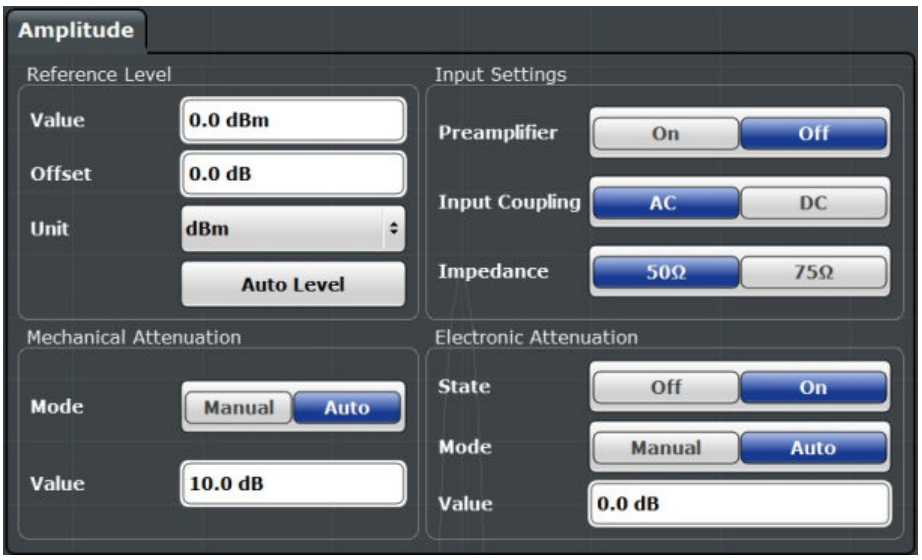
Amplitude settings determine how the R&S FSW must process or display the expected input power levels.

To configure the amplitude settings

Amplitude settings can be configured via the AMPT key or in the "Amplitude" dialog box.

► To display the "Amplitude" dialog box, do one of the following:

- Select "Input/Frontend" from the "Overview" and then switch to the "Amplitude" tab.
- Select the AMPT key and then the "Amplitude Config" softkey.



Reference Level....30
└ Shifting the Display (Offset)....30
RF Attenuation....31
└ Attenuation Mode / Value....31
Using Electronic Attenuation (Option B25)....31
Input Settings....32
└ Preamplifier (option B24)....32

Reference Level
Defines the expected maximum reference level. Signal levels above this value may not be measured correctly, which is indicated by the "IF OVLD" status display.

The reference level is also used to scale power diagrams; the reference level is then used as the maximum on the y-axis.

Since the R&S FSW hardware is adapted according to this value, it is recommended that you set the reference level close above the expected maximum signal level to ensure an optimum measurement (no compression, good signal-to-noise ratio).

Note that the "Reference Level" value ignores the Shifting the Display (Offset). It is important to know the actual power level the R&S FSW must handle.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel` on page 87

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. The scaling of the y-axis is changed accordingly.

Define an offset if the signal is attenuated or amplified before it is fed into the R&S FSW so the application shows correct power results. All displayed power level results will be shifted by this value.

Note, however, that the Reference Level value ignores the "Reference Level Offset". It is important to know the actual power level the R&S FSW must handle.

To determine the required offset, consider the external attenuation or gain applied to the input signal. A positive value indicates that an attenuation took place (R&S FSW increases the displayed power values) , a negative value indicates an external gain (R&S FSW decreases the displayed power values).

The setting range is ±200 dB in 0.01 dB steps.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet` on page 87

RF Attenuation
Defines the attenuation applied to the RF input.

Attenuation Mode / Value ← RF Attenuation
The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). This ensures that the optimum RF attenuation is always used. It is the default setting. By default and when Using Electronic Attenuation (Option B25) is not available, mechanical attenuation is applied.

In "Manual" mode, you can set the RF attenuation in 1 dB steps (down to 0 dB, also using the rotary knob). Other entries are rounded to the next integer value. The range is specified in the data sheet. If the defined reference level cannot be set for the defined RF attenuation, the reference level is adjusted accordingly and the warning "Limit reached" is displayed.

NOTICE! Risk of hardware damage due to high power levels. When decreasing the attenuation manually, ensure that the power level does not exceed the maximum level allowed at the RF input, as an overload may lead to hardware damage.

Remote command:
`INPut:ATTenuation` on page 87
`INPut:ATTenuation:AUTO` on page 88

Using Electronic Attenuation (Option B25)
If option R&S FSW-B25 is installed, you can also activate an electronic attenuator.

In "Auto" mode, the settings are defined automatically; in "Manual" mode, you can define the mechanical and electronic attenuation separately.

Note: Electronic attenuation is not available for stop frequencies (or center frequencies in zero span) >13.6 GHz.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may provide a better signal-to-noise ratio, however.

When you switch off electronic attenuation, the RF attenuation is automatically set to the same mode (auto/manual) as the electronic attenuation was set to. Thus, the RF attenuation may be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

Both the electronic and the mechanical attenuation can be varied in 1 dB steps. Other entries are rounded to the next lower integer value.

If the defined reference level cannot be set for the given attenuation, the reference level is adjusted accordingly and the warning "Limit reached" is displayed in the status bar.

Remote command:
`INPut:EATT:STATe` on page 89
`INPut:EATT:AUTO` on page 89
`INPut:EATT` on page 88

Input Settings
Some input settings affect the measured amplitude of the signal, as well.

The parameters "Input Coupling" and "Impedance" are identical to those in the "Input" settings, see chapter 6.3, "Input Source Settings", on page 27.

Preamplifier (option B24) ← Input Settings
If option R&S FSW-B24 is installed, a preamplifier can be activated for the RF input signal.

For R&S FSW 26 models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW 8 or 13 models, the following settings are available:

You can use a preamplifier to analyze signals from DUTs with low input power.

"Off" Deactivates the preamplifier.

"15 dB" The RF input signal is amplified by about 15 dB.

"30 dB" The RF input signal is amplified by about 30 dB.

Remote command:
`INPut:GAIN:STATe` on page 89
`INPut:GAIN[:VALue]` on page 90

6.4.2 Scaling the Y-Axis

The individual scaling settings that affect the vertical axis are described here.

Note that scaling settings are window-specific, as opposed to the amplitude settings. Depending on the result display, different methods of defining the scaling are available.

To configure the y-axis scaling settings

Vertical Axis settings can be configured via the AMPT key or in the "Amplitude" dialog box.

► To display the "Amplitude" dialog box, do one of the following:

- Select "Amplitude" from the "Overview".
- Select the AMPT key and then the "Scale Config" softkey.

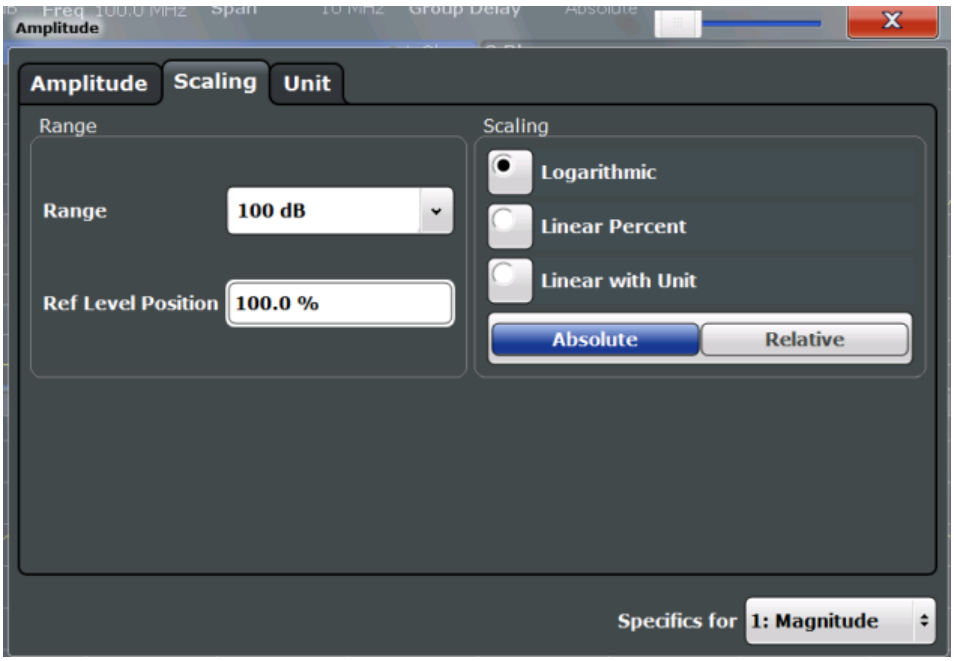


Fig. 6-1: Scaling settings for Magnitude display

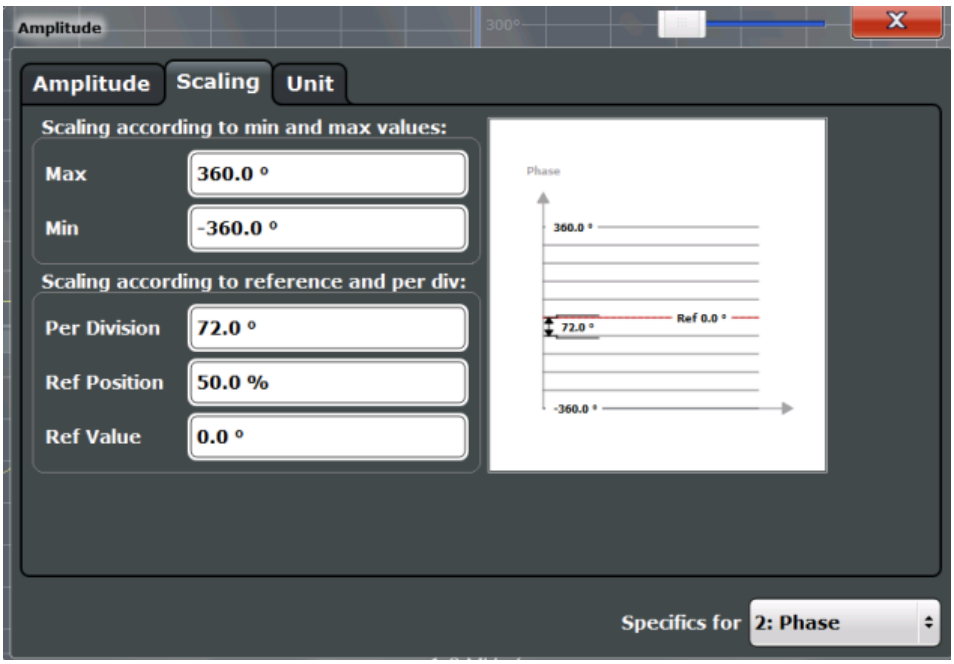


Fig. 6-2: Scaling settings for Phase and Group Delay display

Defining a Range and the Reference Level Position....34
└ Range....34
└ Ref Level Position....34
└ Scaling....34
Configuring a Reference Point and Divisions....34
└ Y-Axis Reference Value....34

└ Y-Axis Reference Position....35
└ Range per Division....35
Defining Min and Max Values....35
Scale Mode....35

Defining a Range and the Reference Level Position
For Magnitude displays, you can define the position of the reference level (for linear scaling), or define the range in dB and the position of the reference level.

Range ← Defining a Range and the Reference Level Position
Defines the displayed y-axis range in dB (frequency domain) or Hz (time domain).

The default value is 100 dB or 500 kHz.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]` on page 90

Ref Level Position ← Defining a Range and the Reference Level Position
Defines the reference level position, i.e. the position of the maximum AD converter value on the level axis in %, where 0 % corresponds to the lower and 100 % to the upper limit of the diagram.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 92

Scaling ← Defining a Range and the Reference Level Position
Defines the scaling method for the y-axis.

"Logarithmic"	Logarithmic scaling (only available for logarithmic units - dB...)
"Linear Unit"	Linear scaling in the unit of the measured signal
"Linear Percent"	Linear scaling in percentages from 0 to 100
"Absolute"	The labeling of the level lines refers to the absolute value of the reference level (not available for "Linear Percent")
"Relative"	The scaling is in dB, relative to the reference level (only available for logarithmic units - dB...). The upper line of the grid (reference level) is always at 0 dB.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 93
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE` on page 91

Configuring a Reference Point and Divisions
Defines the displayed range using a reference point and the size of the divisions.

Y-Axis Reference Value ← Configuring a Reference Point and Divisions
Defines a reference value for the y-axis in the current unit. The y-axis is adapted so that the reference value is displayed at the Y-Axis Reference Position.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue` on page 92

Y-Axis Reference Position ← Configuring a Reference Point and Divisions
Defines the position of the Y-Axis Reference Value on the y-axis. The position is defined as a percentage value, where 0 % refers to the bottom edge, 100 % refers to the top edge of the screen. The y-axis is adapted so that the reference value is displayed at the reference position.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition` on page 92

Range per Division ← Configuring a Reference Point and Divisions
Defines the value range to be displayed per division. Since the display consists of 10 divisions by default, the displayed range is:

*Range = 10 * <Range per Division>*

Note: If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the range per division does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision` on page 92

Defining Min and Max Values
Defines the displayed range using minimum and maximum values.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum` on page 91
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum` on page 90

Scale Mode
For Gain display only: Defines the scaling method for the y-axis.

"Logarithmic" Logarithmic scaling (only available for logarithmic units - dB...)

"Linear" Linear scaling in percentages from 0 to 100

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE` on page 91

6.4.3 Units

The units define how the demodulated data is displayed. They are configured in the "Units" tab of the "Amplitude" dialog box.

► To display this dialog box, do one of the following:

- Select the "Amplitude" button in the Analog Demodulation "Overview" and select the "Units" tab.
- Select the MEAS CONFIG key and then the "Unit Config" softkey.

Phase Unit (Rad/Deg)....36

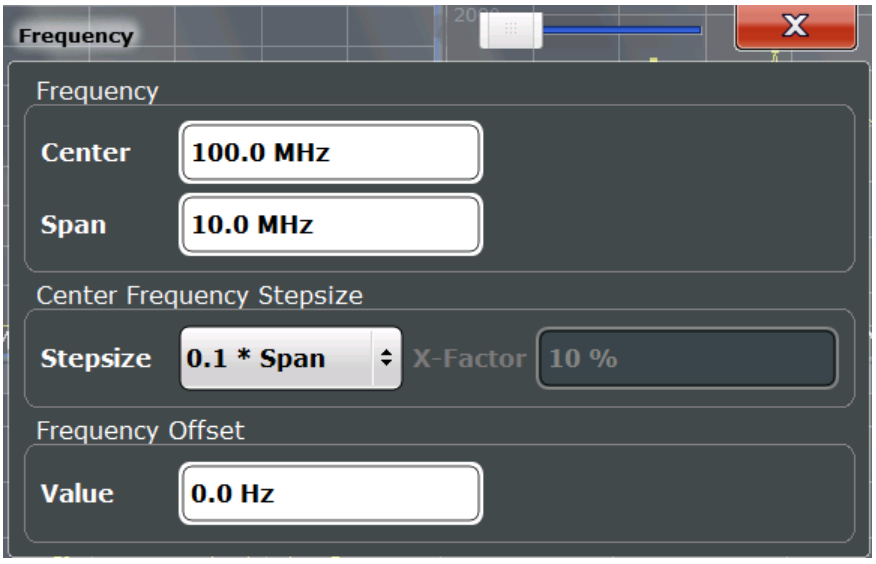
Phase Unit (Rad/Deg)
Sets the phase unit to rad or deg for displaying phase signals.

Remote command:
`UNIT:ANGLe` on page 93

6.5 Frequency Settings

Frequency settings for the input signal can be configured via the "Frequency" dialog box, which is displayed when you do one of the following:

- Select the FREQ key and then the "Frequency Config" softkey.
- Select "Frequency" in the configuration "Overview".



Center....37
Span....37
Center Frequency Stepsize....37
Frequency Offset....37

Center
Defines the normal center frequency of the signal. The allowed range of values for the center frequency depends on the frequency span.

f_{max} and $span_{min}$ are specified in the data sheet.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 93

Span
Defines the frequency span to be measured. Only a multiple of the carrier spacing can be defined. The Number of Carriers is adapted accordingly (see "Span" on page 20).

Remote command:
`[SENSe:]FREQuency:SPAN` on page 104

Center Frequency Stepsize
Defines the step size by which the center frequency is increased or decreased when the arrow keys are pressed. When you use the rotary knob the center frequency changes in steps of only 1/10 of the "Center Frequency Stepsize".

The step size can be coupled to another value or it can be manually set to a fixed value.

"X * Span" Sets the step size for the center frequency to a defined factor of the span. The "X-Factor" defines the percentage of the span.
Values between 1 and 100 % in steps of 1 % are allowed. The default setting is 10 %.

"= Center" Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.

"= Marker" This setting is only available if a marker is active.
Sets the step size to the value of the current marker and removes the coupling of the step size to span. The used value is indicated in the "Value" field.

"Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 94

Frequency Offset
Shifts the displayed frequency range along the x-axis by the defined offset.

This parameter has no effect on the R&S FSW hardware, or on the captured data or on data processing. It is simply a manipulation of the final results in which absolute frequency values are displayed. Thus, the x-axis of a spectrum display is shifted by a constant offset if it shows absolute frequencies, but not if it shows frequencies relative to the signal's center frequency.

A frequency offset can be used to correct the display of a signal that is slightly distorted by the measurement setup, for example.

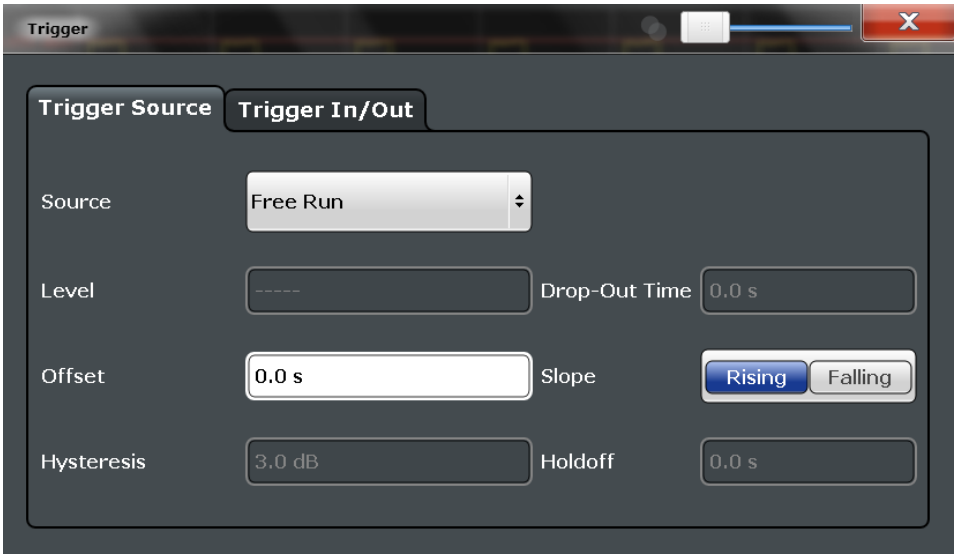
The allowed values range from -100 GHz to 100 GHz. The default setting is 0 Hz.

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 95

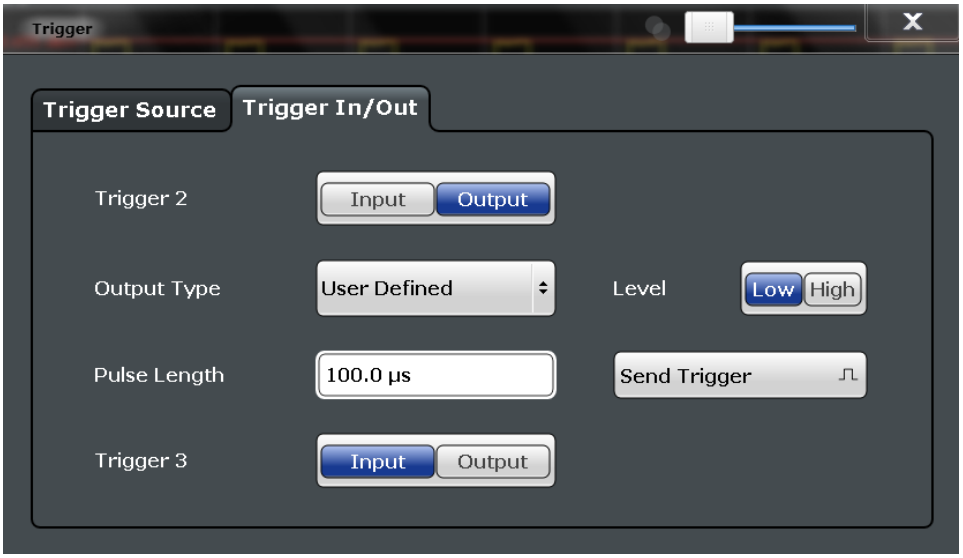
6.6 Trigger Settings

Trigger settings determine when the input signal is measured.

Trigger settings can be configured via the TRIG key or in the "Trigger" dialog box, which is displayed when you select the "Trigger" button in the "Overview".



External triggers from one of the TRIGGER INPUT/OUTPUT connectors on the R&S FSW are configured in a separate tab of the dialog box.



For step-by-step instructions on configuring triggered measurements, see the main R&S FSW User Manual.

Trigger Source....39
└ Trigger Source....39
└ Free Run....39
└ External Trigger 1/2/3....39

└ IF Power....40
└ RF Power....40
└ IQ Power....40
└ Trigger Level....41
└ Drop-Out Time....41
└ Trigger Offset....41
└ Hysteresis....41
└ Trigger Holdoff....41
└ Slope....42
Trigger 2/3....42
└ Output Type....42
└ Level....42
└ Pulse Length....42
└ Send Trigger....43

Trigger Source
The trigger settings define the beginning of a measurement.

Trigger Source ← Trigger Source
Defines the trigger source. If a trigger source other than "Free Run" is set, "TRG" is displayed in the channel bar and the trigger source is indicated.

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 99

Free Run ← Trigger Source ← Trigger Source
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitely.

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 99

External Trigger 1/2/3 ← Trigger Source ← Trigger Source
Data acquisition starts when the TTL signal fed into the specified input connector (on the front or rear panel) meets or exceeds the specified trigger level.

(See "Trigger Level" on page 41).

Note: The "External Trigger 1" softkey automatically selects the trigger signal from the TRIGGER INPUT connector on the front panel.

For details see the "Instrument Tour" chapter in the R&S FSW Getting Started manual.

"External Trigger 1"
Trigger signal from the TRIGGER INPUT connector on the front panel.

"External Trigger 2"
Trigger signal from the TRIGGER INPUT/OUTPUT connector on the front panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 42).

"External Trigger 3"
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector on the rear panel.
Note: Connector must be configured for "Input" in the "Outputs" configuration (see "Trigger 2/3" on page 42).

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`
See `TRIGger[:SEQuence]:SOURce` on page 99

IF Power ← Trigger Source ← Trigger Source
The R&S FSW starts capturing data as soon as the trigger threshold is exceeded around the third intermediate frequency.

For frequency sweeps, the third IF represents the start frequency. The trigger bandwidth at the third IF depends on the RBW and sweep type.

For measurements on a fixed frequency (e.g. zero span or I/Q measurements), the third IF represents the center frequency.

The trigger threshold depends on the defined trigger level, as well as on the RF attenuation and preamplification. For details on available trigger levels and trigger bandwidths see the data sheet.

This trigger source is only available for RF input.

Note: Be aware that in auto sweep type mode, due to a possible change in sweep types, the trigger bandwidth may vary considerably for the same RBW setting.

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 99

RF Power ← Trigger Source ← Trigger Source
Defines triggering of the measurement via signals which are outside the displayed measurement range.

For this purpose the instrument uses a level detector at the first intermediate frequency. The input signal must be in the frequency range between 500 MHz and 8 GHz. The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels see the data sheet.

Note: If the input signal contains frequencies outside of this range (e.g. for fullspan measurements), the sweep may be aborted and a message indicating the allowed input frequencies is displayed in the status bar.

A "Trigger Offset", "Trigger Polarity" and "Trigger Holdoff" (to improve the trigger stability) can be defined for the RF trigger, but no "Hysteresis".

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 99

IQ Power ← Trigger Source ← Trigger Source
This trigger source is not available if the optional Digital Baseband Interface (R&S FSW-B17) or Analog Baseband Interface (R&S FSW-B71) is used for input.

Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 99

Trigger Level ← Trigger Source
Defines the trigger level for the specified trigger source.

For details on supported trigger levels, see the data sheet.

Remote command:
`TRIGger[:SEQuence]:LEVel:IFPower` on page 98
`TRIGger[:SEQuence]:LEVel:IQPower` on page 98
`TRIGger[:SEQuence]:LEVel[:EXTernal<port>]` on page 97

Drop-Out Time ← Trigger Source
Defines the time the input signal must stay below the trigger level before triggering again.

Remote command:
`TRIGger[:SEQuence]:DTIMe` on page 96

Trigger Offset ← Trigger Source
Defines the time offset between the trigger event and the start of the sweep.

offset > 0:	Start of the sweep is delayed
offset < 0:	Sweep starts earlier (pre-trigger)

Remote command:
`TRIGger[:SEQuence]:HOLDoff[:TIME]` on page 96

Hysteresis ← Trigger Source
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Settting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.

This setting is only available for "IF Power" trigger sources. The range of the value is between 3 dB and 50 dB with a step width of 1 dB.

Remote command:
`TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 97

Trigger Holdoff ← Trigger Source
Defines the minimum time (in seconds) that must pass between two trigger events. Trigger events that occur during the holdoff time are ignored.

Remote command:
`TRIGger[:SEQuence]:IFPower:HOLDoff` on page 96

Slope ← Trigger Source
For all trigger sources except time you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
`TRIGger[:SEQuence]:SLOPe` on page 99

Trigger 2/3
Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

"Trigger 2": TRIGGER INPUT/OUTPUT connector on the front panel

"Trigger 3": TRIGGER 3 INPUT/ OUTPUT connector on the rear panel

(Trigger 1 is INPUT only.)

Note: Providing trigger signals as output is described in detail in the R&S FSW User Manual.

"Input" The signal at the connector is used as an external trigger source by the R&S FSW. No further trigger parameters are available for the connector.

"Output" The R&S FSW sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 101
`OUTPut:TRIGger<port>:DIRection` on page 100

Output Type ← Trigger 2/3
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the R&S FSW triggers.

"Trigger Armed" Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9).

"User Defined" Sends a trigger when user selects "Send Trigger" button.
In this case, further parameters are available for the output signal.

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 101

Level ← Output Type ← Trigger 2/3
Defines whether a constant high (1) or low (0) signal is sent to the output connector.

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 101

Pulse Length ← Output Type ← Trigger 2/3
Defines the length of the pulse sent as a trigger to the output connector.

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 102

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

Which pulse level will be sent is indicated by a graphic on the button.

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 102

6.7 Multi-Carrier Configuration

The multiple carriers are configured in the "Multi-Carrier Config" dialog box.

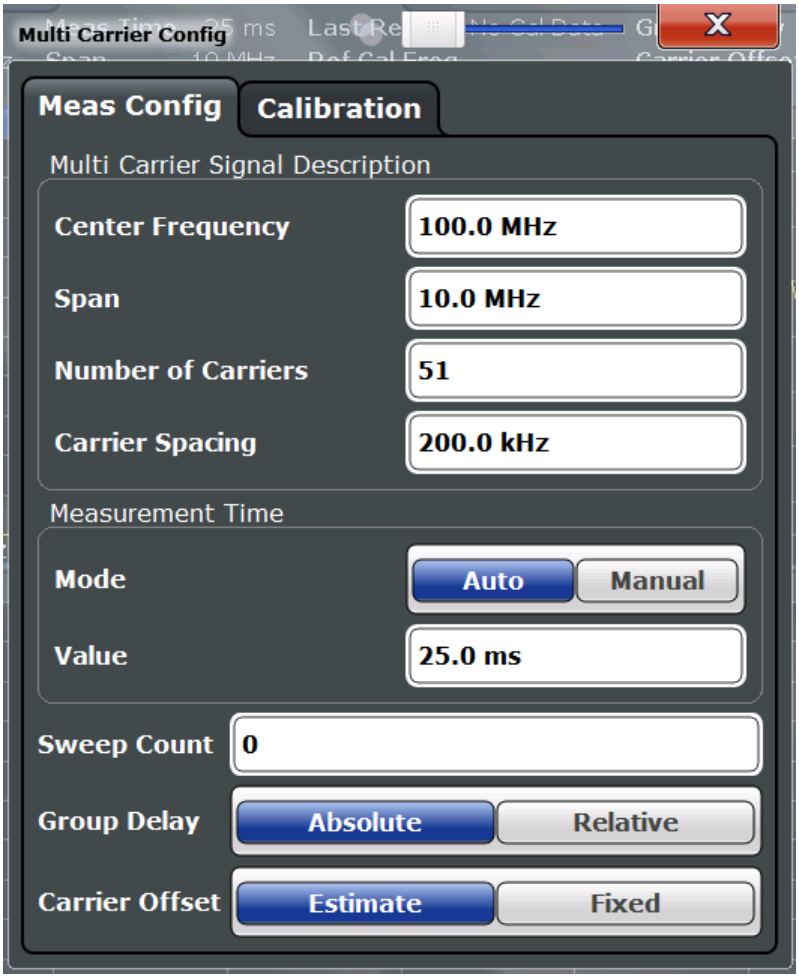
To display this dialog box, do one of the following:

- Select the "Multi-Carrier Config" button in the "Overview".
- Select the MEAS CONFIG key and then the "Multi-Carrier Config" softkey.

- Measurement Configuration.....43
- Calibration.....46

6.7.1 Measurement Configuration

The measurement parameters for group delay calculation are configured in the "Meas Config" tab of the "Multi-Carrier Config" dialog box.



Center....44
Span....45
Number of Carriers....45
Carrier Spacing....45
Measurement Time....45
Sweep Count....45
Group Delay Mode....46
Carrier Offset....46

Center
Defines the normal center frequency of the signal. The allowed range of values for the center frequency depends on the frequency span.

f_{max} and $span_{min}$ are specified in the data sheet.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 93

Span
Defines the frequency span to be measured. Only a multiple of the carrier spacing can be defined. The Number of Carriers is adapted accordingly (see "Span" on page 20).

Remote command:
`[SENSe:]FREQuency:SPAN` on page 104

Number of Carriers
Defines the number of carriers in the signal. The "Span" on page 37 and Carrier Spacing are adapted according to the following formula:

Number of carriers -1 = Span / Carrier spacing

Note: When loading calibration data, the number of carriers in the stored data must correspond to the currently defined number of carriers for the measurement, otherwise loading fails.

For details see "Span" on page 20.

Remote command:
`[SENSe:]CARRier:COUNt` on page 103

Carrier Spacing
Defines the spacing between two carriers. The "Span" on page 37 and the Number of Carriers are adapted accordingly (see "Span" on page 20).

Remote command:
`[SENSe:]CARRier:SPACing` on page 103

Measurement Time
Defines the duration of the measurement

"Auto"	(Default:) In automatic mode the required time is determined according to carrier spacing and span; the currently used measurement time is indicated for reference only
"Manual"	The measurement time is defined manually; enter the measurement time in seconds

Remote command:
`[SENSe:]MTIMe?` on page 104
`[SENSe:]MTIMe:AUTO` on page 104

Sweep Count
Defines the number of sweeps to be performed in the single sweep mode. Values from 0 to 32767 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in all diagrams.

During calibration measurements, the phase and amplitude values are averaged over the defined number of sweeps.

If the trace configurations "Average", "Max Hold" or "Min Hold" are set, this value also determines the number of averaging or maximum search procedures.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

Remote command:
[SENSe:]SWEep:COUNt on page 121

Group Delay Mode
Defines how the group delay is calculated.

"Absolute" Calculates the absolute group delay; requires an external trigger

"Relative" Calculates the relative group delay; constant delay parts are compensated for

Remote command:
CALCulate:GRPDelay:MODE on page 103

Carrier Offset
Defines the offset of the carrier compared to the center frequency so the offset can be compensated in the display.

"Estimated" The actual frequency is estimated from the measurement data and the offset from the reference signal is determined.
Possible values are in the range of:
- (Carrier spacing / 2) to + (Carrier spacing / 2)

"Fixed" A fixed offset is used, depending on the number of carriers:
Odd number: offset = 0
Even number: ofset = Carrier spacing / 2
A fixed offset is useful for signals with very low levels as the frequency estimation may fail in this case.

Remote command:
[SENSe:]CARRier:OFFSet? on page 104
[SENSe:]CARRier:OFFSet:MODE on page 105

6.7.2 Calibration

Calibration is performed in the "Calibration" tab of the "Multi-Carrier Config" dialog box.

The values defined by the most recently performed or loaded calibration measurement are displayed at the top of the dialog box.

Calibrate (Execute Reference Calibration)....47
Storing Calibration Data....47
Loading Calibration Data....48
Decimal Separator....48

Calibrate (Execute Reference Calibration)
Starts a new sweep to perform a calibration measurement. The status of the running measurement is indicated in a dialog box. During this time, no other actions can be performed on the R&S FSW. The results are used as reference data for the group delay calculation.

The date and time of the most recently performed or loaded calibration measurement is indicated in the channel bar and at the top of the dialog box.

Remote command:
`CALibration:MCGD` on page 108

Storing Calibration Data
Stores the calibration data (reference data) to the selected file (`.csv` format)

Remote command:
`MMEMory:STORe:MCGD:RCALibration` on page 109

Loading Calibration Data
Loads the calibration data (reference data) from the selected file (`.csv` format) to the instrument. The current reference data in the MCGD application is overwritten; the loaded data is used for the group delay calculation.

Note: When loading calibration data, the number of carriers in the stored data must correspond to the currently defined number of carriers for the measurement, otherwise loading fails.

Remote command:
`MMEMory:LOAD:MCGD:RCALibration` on page 109

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 126

6.8 Sweep Settings

The sweep settings define how often data from the input signal is acquired and then evaluated. They are configured via the SWEEP key.

Continuous Sweep/RUN CONT....48
Single Sweep/ RUN SINGLE....48
Continue Single Sweep....49
Sweep Count....49

Continuous Sweep/RUN CONT
While the measurement is running, the "Continuous Sweep" softkey and the RUN CONT key are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again. The results are not deleted until a new measurement is started.

Note: Sequencer. If the Sequencer is active, the "Continuous Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in continuous sweep mode is swept repeatedly. Furthermore, the RUN CONT key on the front panel controls the Sequencer, not individual sweeps. RUN CONT starts the Sequencer in continuous mode.

Remote command:
`INITiate:CONTinuous` on page 118

Single Sweep/ RUN SINGLE
While the measurement is running, the "Single Sweep" softkey and the RUN SINGLE key are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Note: Sequencer. If the Sequencer is active, the "Single Sweep" softkey only controls the sweep mode for the currently selected channel; however, the sweep mode only has

an effect the next time the Sequencer activates that channel, and only for a channel-defined sequence. In this case, a channel in single sweep mode is swept only once by the Sequencer.
Furthermore, the RUN SINGLE key on the front panel controls the Sequencer, not individual sweeps. RUN SINGLE starts the Sequencer in single mode.

If the Sequencer is off, only the evaluation for the currently displayed measurement channel is updated.

Remote command:
`INITiate[:IMMediate]` on page 118

Continue Single Sweep
While the measurement is running, the "Continue Single Sweep" softkey and the RUN SINGLE key are highlighted. The running measurement can be aborted by selecting the highlighted softkey or key again.

Remote command:
`INITiate:CONMeas` on page 117

Sweep Count
Defines the number of sweeps to be performed in the single sweep mode. Values from 0 to 32767 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in all diagrams.

During calibration measurements, the phase and amplitude values are averaged over the defined number of sweeps.

If the trace configurations "Average", "Max Hold" or "Min Hold" are set, this value also determines the number of averaging or maximum search procedures.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

Remote command:
`[SENSe:]SWEep:COUNt` on page 121

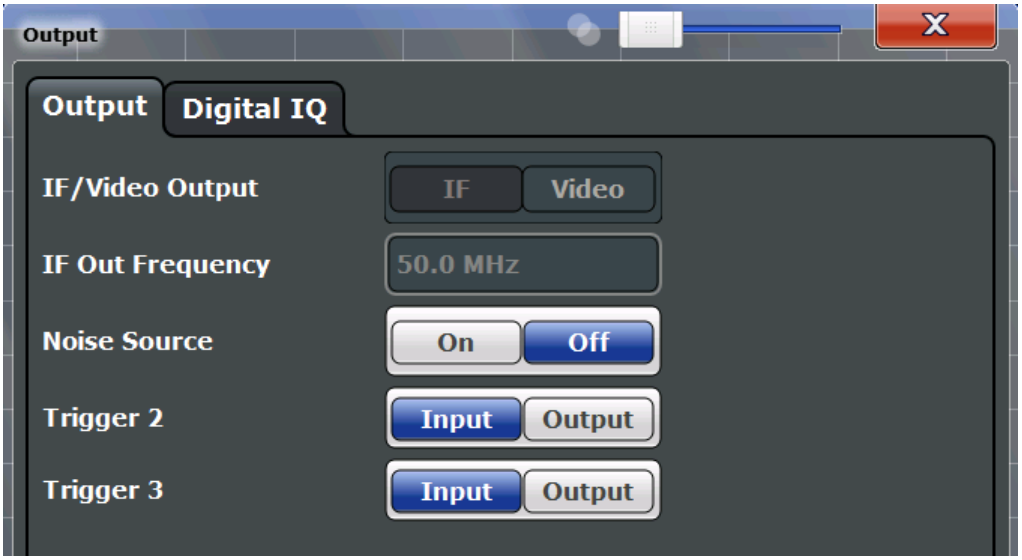
6.9 Output Settings

The R&S FSW can provide output to special connectors for other devices.

For details on connectors refer to the R&S FSW Getting Started manual, "Front / Rear Panel View" chapters.

How to provide trigger signals as output is described in detail in the R&S FSW User Manual.

Output settings can be configured via the INPUT/OUTPUT key or in the "Outputs" dialog box.



Noise Source....50
Trigger 2/3....50
└ Output Type....51
└ Level....51
└ Pulse Length....51
└ Send Trigger....51

Noise Source
Switches the supply voltage for an external noise source on or off.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S FSW itself, for example when measuring the noise level of a DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 105

Trigger 2/3
Defines the usage of the variable TRIGGER INPUT/OUTPUT connectors, where:

"Trigger 2": TRIGGER INPUT/OUTPUT connector on the front panel

"Trigger 3": TRIGGER 3 INPUT/ OUTPUT connector on the rear panel

(Trigger 1 is INPUT only.)

Note: Providing trigger signals as output is described in detail in the R&S FSW User Manual.

"Input" The signal at the connector is used as an external trigger source by the R&S FSW. No further trigger parameters are available for the connector.

"Output" The R&S FSW sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
OUTPut:TRIGger<port>:LEVel on page 101
OUTPut:TRIGger<port>:DIRection on page 100

Output Type ← Trigger 2/3
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the R&S FSW triggers.

"Trigger Armed" Sends a (high level) trigger when the R&S FSW is in "Ready for trigger" state.
This state is indicated by a status bit in the STATus:OPERation register (bit 5), as well as by a low level signal at the AUX port (pin 9).

"User Defined" Sends a trigger when user selects "Send Trigger" button.
In this case, further parameters are available for the output signal.

Remote command:
OUTPut:TRIGger<port>:OTYPe on page 101

Level ← Output Type ← Trigger 2/3
Defines whether a constant high (1) or low (0) signal is sent to the output connector.

Remote command:
OUTPut:TRIGger<port>:LEVel on page 101

Pulse Length ← Output Type ← Trigger 2/3
Defines the length of the pulse sent as a trigger to the output connector.

Remote command:
OUTPut:TRIGger<port>:PULSe:LENGth on page 102

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

Which pulse level will be sent is indicated by a graphic on the button.

Remote command:
OUTPut:TRIGger<port>:PULSe:IMMediate on page 102

6.10 Automatic Settings

Some settings can be adjusted by the R&S FSW automatically according to the current measurement settings and signal characteristics.

MSRA operating mode

In MSRA operating mode, the following automatic settings are not available, as they require a new data acquisition. However, the GSM application cannot perform data acquisition in MSRA operating mode.

To activate the automatic adjustment of a setting, select the corresponding function in the AUTO SET menu.

Setting the Reference Level Automatically (Auto Level)....52
Resetting the Automatic Measurement Time (Meastime Auto)....52
Changing the Automatic Measurement Time (Meastime Manual)....52
Upper Level Hysteresis....52
Lower Level Hysteresis....53

Setting the Reference Level Automatically (Auto Level)

Automatically determines the optimal reference level for the current input data. At the same time, the internal attenuators and the preamplifier (for analog baseband input: the fullscale level) are adjusted so the signal-to-noise ratio is optimized, while signal compression, clipping and overload conditions are minimized.

In order to do so, a level measurement is performed to determine the optimal reference level.

You can change the measurement time for the level measurement if necessary (see "Changing the Automatic Measurement Time (Meastime Manual)" on page 52).

Remote command:

[SENSe:]ADJust:LEVel on page 108

Resetting the Automatic Measurement Time (Meastime Auto)

Resets the measurement duration for automatic settings to the default value.

Remote command:

[SENSe:]ADJust:CONFigure:DURation:MODE on page 106

Changing the Automatic Measurement Time (Meastime Manual)

This function allows you to change the measurement duration for automatic setting adjustments. Enter the value in seconds.

Remote command:

[SENSe:]ADJust:CONFigure:DURation:MODE on page 106
[SENSe:]ADJust:CONFigure:DURation on page 106

Upper Level Hysteresis

When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Remote command:

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer on page 107

Lower Level Hysteresis
When the reference level is adjusted automatically using the Auto Level function, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Remote command:
`[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer` on page 107

7 Analysis

General result analysis settings concerning the trace, markers, windows etc. can be configured via the "Analysis" button in the "Overview". They are identical to the analysis functions in the base unit except for the special window functions.

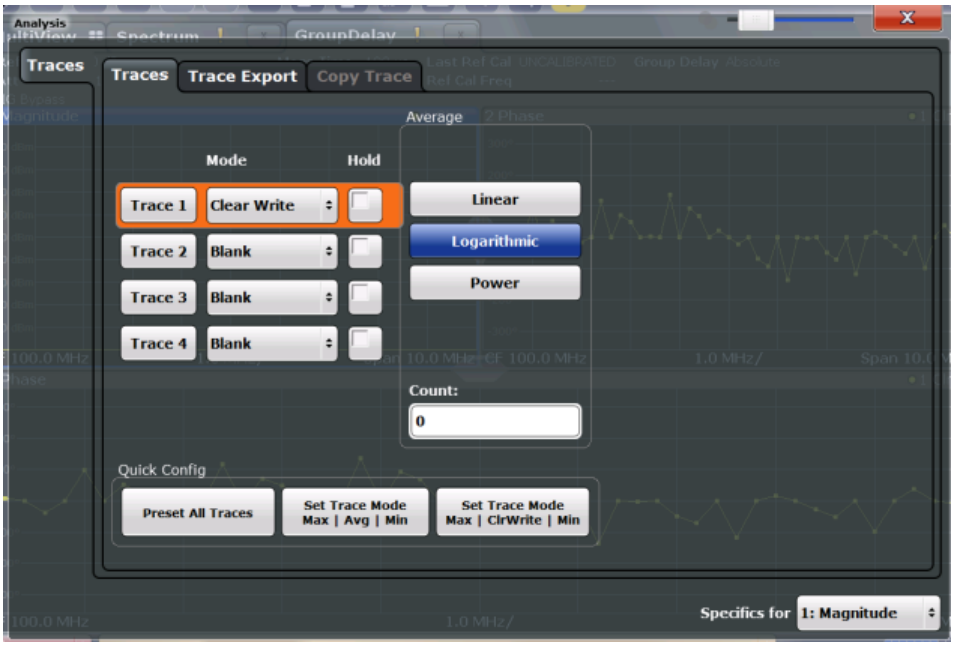
- Trace Settings....54
- Trace Export Settings....57
- Markers....58
- Display Configuration....66
- Zoom Functions....66

7.1 Trace Settings

The trace settings determine how the measured data is analyzed and displayed in the window. Depending on the result display, between 1 and 4 traces may be displayed.

Trace settings can be configured via the TRACE key, in the "Traces" dialog box, or in the vertical "Traces" tab of the "Analysis" dialog box.

Trace data can also be exported to an ASCII file for further analysis. For details see chapter 7.2, "Trace Export Settings", on page 57.



Trace 1/Trace 2/Trace 3/Trace 4....55
Mode....55
Hold....55
Average Mode....55

Average Count....56
Predefined Trace Settings - Quick Config....56
Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)....57

Trace 1/Trace 2/Trace 3/Trace 4
Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 129
Selected via numeric suffix of `TRACe<t>` commands

Mode
Defines the update mode for subsequent traces.

"Clear Write" Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

"Max Hold" The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

"Min Hold" The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

"Average" The average is formed over several sweeps.
The "Average Count" on page 56 determines the number of averaging procedures.

"View" The current contents of the trace memory are frozen and displayed.

"Blank" Removes the selected trace from the display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 128

Hold
If activated, traces in "Min Hold", "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started anew after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous` on page 128

Average Mode
Defines the mode with which the trace is averaged over several sweeps. A different averaging mode can be defined for each trace.

This setting is only applicable if trace mode "Average" is selected.

How many sweeps are averaged is defined by the "Average Count" on page 56.

"Linear" The power level values are converted into linear units prior to averaging. After the averaging, the data is converted back into its original unit.

"Logarithmic" For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.

"Power" Activates linear power averaging.
The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.
Use this mode to average power values in Volts or Amperes correctly.

Remote command:
`[SENSe:]AVERage<n>:TYPE` on page 130

Average Count
Determines the number of averaging or maximum search procedures If the trace modes "Average", "Max Hold" or "Min Hold" are set.

In continuous sweep mode, if sweep count = 0 (default), averaging is performed over 10 sweeps. For sweep count =1, no averaging, maxhold or minhold operations are performed.

This value is identical to the Sweep Count setting in the "Sweep" and "Multi-carrier" configuration.

Remote command:
`[SENSe:]AVERage:COUNt` on page 129

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

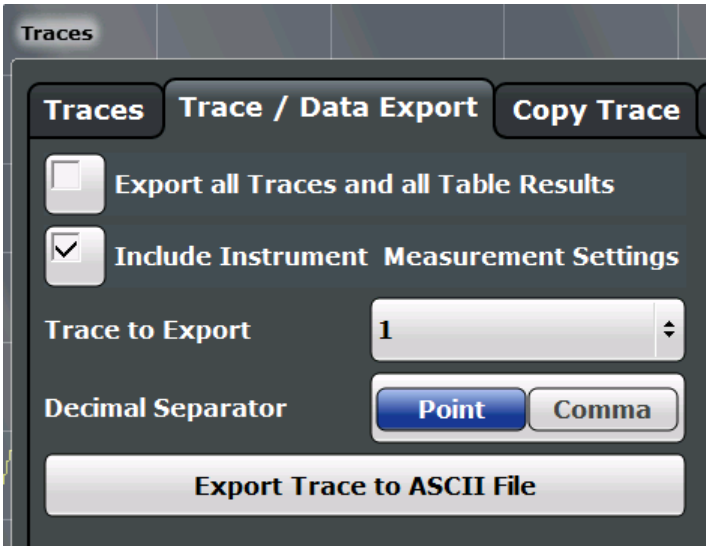
Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
	Traces 2-4:	Blank
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
	Trace 4:	Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
	Trace 4:	Blank

Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 129

7.2 Trace Export Settings

Trace settings can be configured in the "Traces" dialog box or in the vertical "Traces" tab of the "Analysis" dialog box. Switch to the "Trace/Data Export" tab.



Export all Traces and all Table Results....57
Include Instrument Measurement Settings....57
Trace to Export....58
Decimal Separator....58
Export Trace to ASCII File....58

Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

Remote command:
`FORMat:DEXPort:TRACes` on page 127

Include Instrument Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

See chapter 12.2, "Reference: ASCII File Export Format", on page 147 for details.

Remote command:
`FORMat:DEXPort:HEADer` on page 126

Trace to Export
Defines an individual trace that will be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 126

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Both measurement and reference (calibration) traces can be exported to an ASCII file. However, the calibration data stored in an ASCII file cannot be re-imported to the R&S FSW (to re-import the data use Storing Calibration Data instead).

Note: To store the measurement results for **all** traces in all windows in `.csv` format, use the Storing Measurement Results command in the "Save/Recall" > "Export" menu.

For details on the file formats see chapter 12, "Annex", on page 147.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 126

7.3 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

Markers are configured in the "Marker" dialog box which is displayed when you do one of the following:

- In the "Overview", select "Analysis", and switch to the vertical "Marker" tab.
- Press the MKR key, then select the "Marker Config" softkey.

- Marker Settings.....58
- Marker Search Settings and Positioning Functions.....63

7.3.1 Marker Settings

Marker settings can be configured via the MARKER key or in the "Marker" dialog box. To display the "Marker" dialog box, do one of the following:

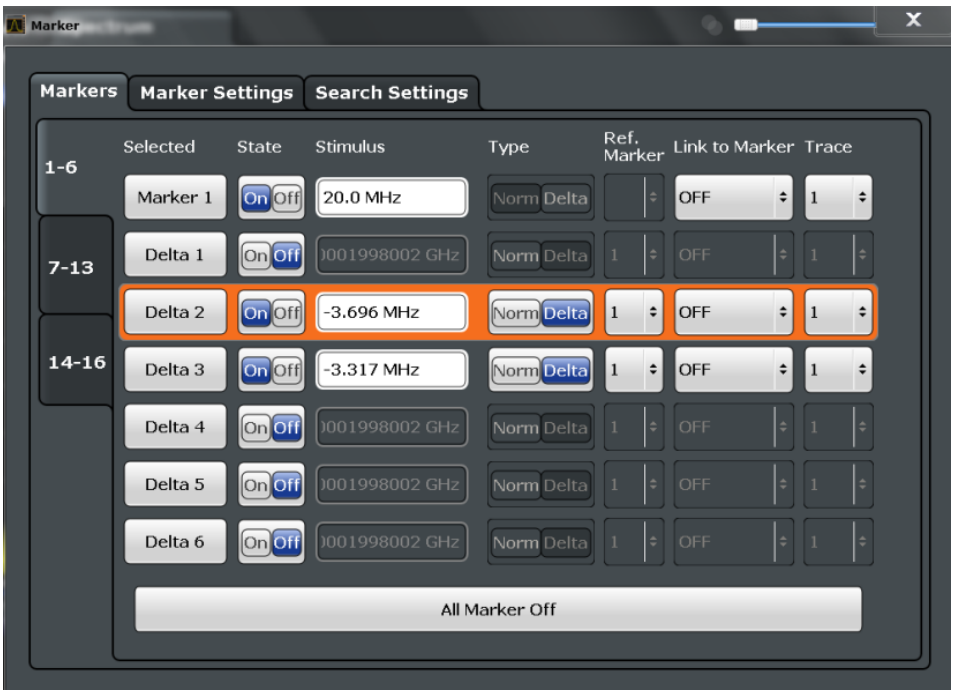
- Press the MKR key, then select the "Marker Config" softkey.
- In the "Overview", select "Analysis", and switch to the vertical "Marker" tab.

The remote commands required to define these settings are described in chapter 11.9.3, "General Marker Settings", on page 134.

- Individual Marker Setup....59
- General Marker Settings....61

7.3.1.1 Individual Marker Setup

In the Mutli-Carrier Group Delay application, up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.



The markers are distributed among 3 tabs for a better overview. By default, the first marker is defined as a normal marker, whereas all others are defined as delta markers with reference to the first marker. All markers are assigned to trace 1, but only the first marker is active.

Select Marker....59
Selected Marker....60
Marker State....60
Marker Position (X-value)....60
Marker Type....60
Reference Marker....61
Linking to Another Marker....61
Assigning the Marker to a Trace....61
All Markers Off....61

Select Marker
Opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
Marker selected via suffix <m> in remote commands.

Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

Remote command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 133
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 132

Marker Position (X-value)
Defines the position (x-value) of the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>:X` on page 134
`CALCulate<n>:DELTamarker<m>:X` on page 132

Marker Type
Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 133
CALCulate<n>:DELTamarker<m>[:STATe] on page 132

Reference Marker
Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

Remote command:
CALCulate<n>:DELTamarker<m>:MREF on page 132

Linking to Another Marker
Links the current marker to the marker selected from the list of active markers. If the x-axis value of the inital marker is changed, the linked marker follows on the same x-position. Linking is off by default.

Using this function you can set two markers on different traces to measure the difference (e.g. between a max hold trace and a min hold trace or between a measurement and a reference trace).

Remote command:
CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> on page 133
CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> on page 131
CALCulate<n>:DELTamarker<m>:LINK on page 131

Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
CALCulate<n>:MARKer<m>:TRACe on page 134

All Markers Off
Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 133

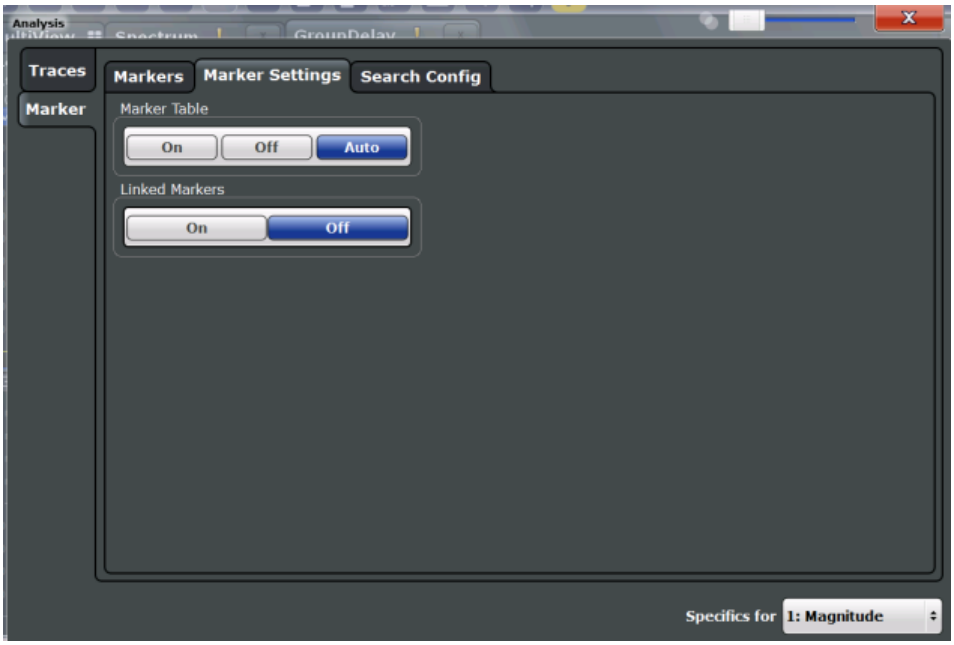
7.3.1.2 General Marker Settings

Some general marker settings allow you to influence the marker behavior for all markers.

These settings are located in the "Marker Settings" tab of the "Marker" dialog box. To display this tab, do one of the following:

- Press the MKR key, then select the "Marker Config" softkey.

- In the "Overview", select "Analysis", and switch to the vertical "Marker" tab. Then select the horizontal "Marker Settings" tab.



Marker Table Display....62
Linked Markers....62

Marker Table Display
Defines how the marker information is displayed.

"On"	Displays the marker information in a table in a separate area beneath the diagram.
"Off"	Displays the marker information within the diagram area.
"Auto"	(Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

Remote command:
`DISPlay:MTABle` on page 134

Linked Markers
If enabled, the markers in all diagrams are linked, i.e. when you move a marker in one window, the markers in all other windows are moved to the same x-value.

Linking markers is only possible if compatible reference data is available, or no reference data at all. Compatible reference data means the settings used to perform calibration were the same as the currently active measurement settings. If measurement settings are changed that do not match the reference data, linking markers is no longer possible and the function is automatically deactivated.

An exception to this rule is the center frequency. If a different center frequency was used for calibration, the markers can still be linked. However, in this case the markers are not moved to a specific x-value, but to the same horizontal position relative to the diagram edge.

Remote command:
`CALCulate<n>:MARKer<m>:LINK` on page 135

7.3.2 Marker Search Settings and Positioning Functions

Several functions are available to set the marker to a specific position very quickly and easily, or to use the current marker position to define another characteristic value. In order to determine the required marker position, searches may be performed. The search results can be influenced by special settings.

Most marker positioning functions and the search settings are available in the MKR -> menu.

Search settings are also available via the MARKER key or in the vertical "Marker Config" tab of the "Analysis" dialog box (horizontal "Search Settings" tab).

The remote commands required to define these settings are described in chapter 11.9.4, "Searching for Peaks and Positioning the Marker", on page 135.

- Marker Search Settings....63
- Positioning Functions....64

7.3.2.1 Marker Search Settings

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.

These settings are available as softkeys in the Marker To menu, or in the "Search Settings" tab of the "Marker" dialog box. To display this tab, do one of the following:

- Press the MKR key, then select the "Marker Config" softkey. Then select the horizontal "Search Settings" tab.
- In the "Overview", select "Analysis", and switch to the vertical "Marker Config" tab. Then select the horizontal "Search Settings" tab.

Search Mode for Next Peak....63
Peak Excursion....64

Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left"	Determines the next maximum/minimum to the left of the current peak.
"Absolute"	Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT on page 138
CALCulate<n>:MARKer<m>:MAXimum:LEFT on page 136
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 138
CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 136
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt on page 138
CALCulate<n>:MARKer<m>:MAXimum:RIGHt on page 137
CALCulate<n>:DELTamarker<m>:MINimum:LEFT on page 139
CALCulate<n>:MARKer<m>:MINimum:LEFT on page 137
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 139
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 137
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt on page 139
CALCulate<n>:MARKer<m>:MINimum:RIGHt on page 137

Peak Excursion
Defines the minimum level value by which a signal must rise or fall so that it will be identified as a maximum or a minimum by the search functions.

Remote command:
CALCulate<n>:MARKer:PEXCursion on page 135

7.3.2.2 Positioning Functions

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value. These functions are available as softkeys in the "Marker To" menu, which is displayed when you press the MKR -> key, or in the "Marker" menu.

Select Marker....64
Peak Search....65
Search Next Peak....65
Search Minimum....65
Search Next Minimum....65

Select Marker
Opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
Marker selected via suffix <m> in remote commands.

Peak Search
Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 136
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 138

Search Next Peak
Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 136
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 138

Search Minimum
Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 137
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 139

Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 137
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 139

7.4 Display Configuration

The captured signal can be displayed using various evaluation methods. All evaluation methods available for the Multi-Carrier Group Delay application are displayed in the evaluation bar in SmartGrid mode when you do one of the following:

- Select the "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the "Overview".
- Press the MEAS key.
- Select the "Display Config" softkey in any Multi-Carrier Group Delay menu.

Up to 6 evaluation methods can be displayed simultaneously in separate windows. The Multi-Carrier Group Delay evaluation methods are described in chapter 4.1, "Evaluation Methods for Multi-Carrier Group Delay", on page 15.

For details on working with the SmartGrid see the R&S FSW Getting Started manual.

7.5 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom....66
Multiple Zoom....66
Restore Original Display....67
Deactivating Zoom (Selection mode)....67

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

Remote command:

`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 140

`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 139

Multiple Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 141
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 140

Restore Original Display

Restores the original display and closes all zoom windows.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 140 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 141 (for each multiple zoom window)

Deactivating Zoom (Selection mode)

Deactivates zoom mode; tapping the screen no longer invokes a zoom, but selects an object.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 140 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 141 (for each multiple zoom window)

8 Importing and Exporting Results

The R&S FSW provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with other, external applications. In this case, you can export the measurement data to a standard format file (ASCII or CSV). The results from the calibration measurements can also be be re-imported to the R&S FSW MCGD application as reference data for further measurements.

The standard data management functions (e.g. saving or loading instrument settings) that are available for all R&S FSW applications are not described here.

See the R&S FSW User Manual for a description of the standard functions.

- Export Functions....68
- Import Functions....69

8.1 Export Functions

The following export functions are available via softkeys in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar. Some functions are also available via softkeys or dialog boxes in the corresponding menus, e.g. trace data or calibration data.

Storing Calibration Data....68
Storing Measurement Results....68
Export Trace to ASCII File....69
Decimal Separator....69

Storing Calibration Data
Stores the calibration data (reference data) to the selected file (`.csv` format)

Remote command:
`MMEMory:STORe:MCGD:RCALibration` on page 109

Storing Measurement Results
Stores the currently displayed measurement results (i.e. all traces in all windows) to the selected file (`.csv` format).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Note: To store the results of an individual trace or all traces in ASCII format (`.dat`), use the Export Trace to ASCII File function.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`MMEMory:STORe:MCGD:MEAS` on page 124

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (**.dat**) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Both measurement and reference (calibration) traces can be exported to an ASCII file. However, the calibration data stored in an ASCII file cannot be re-imported to the R&S FSW (to re-import the data use Storing Calibration Data instead).

Note: To store the measurement results for **all** traces in all windows in **.csv** format, use the Storing Measurement Results command in the "Save/Recall" > "Export" menu.

For details on the file formats see chapter 12, "Annex", on page 147.

Remote command:
MMEMory:STORe<n>:TRACe on page 126

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
FORMat:DEXPort:DSEParator on page 126

8.2 Import Functions

The following import functions are available via softkeys in the "Save/Recall" menu which is displayed when you select the "Save" or "Open" icon in the toolbar. Calibration data can also be imported from the "Calibration" configuration dialog box.

Loading Calibration Data....69
Decimal Separator....69

Loading Calibration Data
Loads the calibration data (reference data) from the selected file (**.csv** format) to the instrument. The current reference data in the MCGD application is overwritten; the loaded data is used for the group delay calculation.

Note: When loading calibration data, the number of carriers in the stored data must correspond to the currently defined number of carriers for the measurement, otherwise loading fails.

Remote command:
MMEMory:LOAD:MCGD:RCALibration on page 109

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
FORMat:DEXPort:DSEParator on page 126

9 How to Perform Measurements in the Multi-Carrier Group Delay Application

The following step-by-step instructions demonstrate how to perform a Multi-Carrier Group Delay measurement with the R&S FSW-K17 option. For details on the individual functions and settings see chapter 6, "Configuration", on page 24.

Additionally, the procedure to generate the multi-carrier signal for the frequency range to be analyzed on a signal generator is described, using the R&S SMU as an example. For details on configuring the signal generator, see the R&S SMU User Manual.

To generate a multi-carrier signal for the frequency range of the DUT on an R&S SMU

1. Preset the signal generator.
2. In the "Baseband" menu, select "Multicarrier CW". (Alternatively, the R&S SMU can produce multi-carrier signals using the "ARB" option.)
3. In the "Carrier Setup" area define the "No of Carriers" and "Carrier Spacing" such that the generated signal covers the frequency range in which the DUT is to be analyzed.
4. In the "Optimize Crest Factor Mode" field, select "Chirp" to improve the SNR in the MC Group Delay measurement.
5. To improve measurement accuracy, send a trigger signal to the R&S FSW:
   a) Select the "Trigger/Marker" button.
   b) Select MODE and select "Auto".
   c) Select MARKER 1 and select "Restart".
   d) Exit the "Trigger/Marker" menu.
6. Activate the multi-carrier signal by switching "State" to "ON".
7. Close the "Baseband" menu.
8. Open the "RF/A Mod" menu.
9. In the "RF/A Mod" menu, select "RF ON" to activate the RF modulation.
10. Select the FREQ key to define the center frequency of the test signal.
11. Select the LEVEL key to define the generator's output power.

To perform the MC Group Delay measurement on the R&S FSW

1. To use the trigger from the signal generator on the R&S FSW, for example to calculate an absolute group delay, connect the trigger output of the signal generator (Marker 1 on the R&S SMU in the example above) to the trigger input of the R&S FSW.
2. To synchronize the reference frequencies used by the signal generator and the R&S FSW, use an external reference frequency:

a) Connect the external reference output of the signal generator (REF OUT) to the external reference input on the rear panel of the R&S FSW (REF INPUT 1..20 MHz).
b) On the R&S FSW, press the SETUP key, then select the "Reference" softkey.
c) In the "Reference Frequency Input" area select the used external reference.

3. Connect the signal generator to the RF INPUT connector on the front panel of the R&S FSW **without the DUT**.
4. Configure the signal generator to output a multi-carrier signal in the frequency range in which the DUT is to be analyzed (as described in "To generate a multi-carrier signal for the frequency range of the DUT on an R&S SMU" on page 70).
5. Press the MODE key on the front panel of the R&S FSW and select the "MC Group Delay" application.
6. Select the "Overview" softkey to display the "Overview" for a Multi-Carrier Group Delay measurement.
7. Select the "Amplitude" button and define the required attenuation and reference level for the generated input signal.

   Note: Correct attenuation and reference level settings are an important factor for accurate group delay measurement results. You can also use the auto leveling function in the R&S FSW Spectrum application before starting the MCGD application. The attenuation and reference level values are then passed on to the new MCGD measurement channel.
8. Select the "Frequency" button to define the input signal's center frequency.
9. To measure the absolute group delay select the "Trigger" button and select the trigger source "External Trigger1".
10. Select the "Multi-Carrier Config" button to describe the signal and define measurement settings:

    a) Define the carrier spacing.
    b) Define the number of carriers (tones) or the frequency span according to the settings on the generator.
    c) If the measurement time determined automatically is not adequate, define it manually.
    d) To average the results over several sweeps, increase the sweep count.
    e) To calculate an absolute group delay, select "Absolute" mode for the group delay result.

    Check the displayed results to ensure the measurement configuration is adequate.
11. Press the RUN SINGLE key to stop the continuous sweep mode.
12. Select the "Multi-Carrier Config" softkey to re-open the "Multi-Carrier Config" dialog box and switch to the "Calibration" tab.
13. Select the "Calibrate" button to perform a calibration measurement.

Alternatively, if a calibration measurement has already been performed with the same measurement setup, select the "Load Calibration Data" button to load stored reference data.

The calibration measurement is performed. The status of the running measurement is indicated in a dialog box. During this time, no other actions can be performed on the R&S FSW.
The date and time of the most recently performed or loaded calibration measurement is indicated in the channel bar.

14. Optionally, to store the results from the performed calibration measurement to a CSV file for later use, select the "Store Calibration Data" button.
15. Once the reference data is available in the Multi-Carrier Group Delay application, connect the DUT between the signal generator and the R&S FSW.
16. On the R&S FSW, select the "Display Config" button and select the displays that are of interest to you (up to 6).
    Arrange them on the display to suit your preferences, then exit the SmartGrid mode.
17. Press the RUN SINGLE key to start a new measurement.

    The group delay is calculated and the selected results are displayed.
18. To store the displayed results in a CSV file:
    a) Select the "Save" icon in the toolbar.
    b) Select the "Export" softkey.
    c) If necessary, change the decimal separator to be used for the export file.
    d) Select the "Store Measurement Data" softkey.
    e) Define a file name and storage location for the results file.
19. To make use of the advanced analysis functions in the displays, select the "Analysis" button in the "Overview".
    - Configure a trace to display the average over a series of sweeps (on the "Trace" tab; if necessary, increase the "Sweep Count" in the "Multi-Carrier Config" settings).
      This is recommended for absolute group delay trace results.
    - Configure markers and delta markers to determine deviations and offsets within the signal (on the "Marker" tab).
20. Optionally, export the trace data of the demodulated signal to a file.
    a) In the "Traces" tab of the "Analysis" dialog box, switch to the "Trace Export" tab.
    b) Select "Export Trace to ASCII File".
    c) Define a file name and storage location and select "OK".

10 Optimizing and Troubleshooting the Measurement

If the results do not meet your expectations, try the following methods to optimize the measurement:

Calibration fails

- Check the connection from the signal generator to the R&S FSW.
- Check the settings on the signal generator.
- Check the input signal at the R&S FSW.

No trace visible in "Magnitude Reference" and "Phase Reference" windows

- No calibration data is available, perform a calibration measurement (without the DUT) or load stored calibration data.

No trace visible in "Group Delay" window

- No calibration data is available, perform a calibration measurement (without the DUT) or load stored calibration data.
- MCGD configuration is not compatible to the current calibration (reference) data. Perform a new calibration or adjust measurement settings to fit the calibration data (see chapter 6.7.2, "Calibration", on page 46).

Group delay results are not calculated correctly

- Check the connections from the DUT to the R&S FSW and to the signal generator.
- Repeat the calibration measurement (without the DUT) or load stored calibration data from the same measurement setup.
- Check if the MCGD configuration on the R&S FSW fits to the signal sent by the generator.
- Connect an external reference to the R&S FSW to improve accuracy (see the R&S FSW User Manual).
- Check level settings on both the signal generator in use and the R&S FSW MCGD application. Increase the generator's output level and adjust the reference level of the MCGD application accordingly.
- Check the measurement time. Longer measurement times result in better signal to noise ratios in the group delay calculation. The "Meas Time Auto" mode should provide a suitable value in most cases (see "Measurement Time" on page 45).
- For absolute group delay calculation an external trigger has to be used. Check whether an external trigger is connected and is being sent to the R&S FSW. The trigger periodicity has to be an integer multiple of the signal's periodicity, which is 1/carrier spacing.
- Increase the sweep count for absolute group delay calculation (for example 100 sweeps) to improve the measurement result. Use the sweep count for calibration as well as for group delay measurement (trace averaging) to compensate for trigger inaccuracies.
- Increase the carrier spacing on the used multi-carrier signal to reduce noise in the group delay calculation. Reducing the carrier spacing for multi-carrier signals leads

to a better frequency resolution, but also causes more noise in the calculated group delay.

- For very low signal levels and short measurement times, the frequency estimation used by the MCGD application to determine the exact position of the carriers can degrade the measurement result due to uncompensated intercarrier interference. Increase the signal generator's output level. Alternatively, you can select the carrier offset mode "Fixed". In this case, frequency estimation is disabled and the carrier offset is set to a fixed value: 0 Hz for odd number of carriers and carrier spacing / 2 for even number of carriers accordingly.

10.1 Error and Status Messages

Error messages are entered in the error/event queue of the status reporting system in the remote control mode and can be queried with the command `SYSTem:ERRor?`.

Warnings are not indicated in the status reporting system, but are displayed in the status bar. A short explanation of the warning messages for the R&S FSW MCGD application is given below.

Table 10-1: Status messages for the R&S FSW MCGD application

Status bar message	Description
"No calibration data"	The calibration measurement has not yet been performed, nor have stored settings been loaded.
"Measurement configuration not compatible to Calibration Data"	MCGD configuration contains a setting that is not compatible to the current calibration (reference) data. **Solution:** Repeat the calibration measurement (without the DUT) or change the measurement settings.

11 Remote Commands to Perform Multi-Carrier Group Delay Measurements

The following commands are required to perform measurements in the Multi-Carrier Group Delay application in a remote environment. It is assumed that the R&S FSW has already been set up for remote operation in a network as described in the R&S FSW User Manual.

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S FSW User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation
- Using the common status registers

The following topics specific to Multi-Carrier Group Delay application are described here:

- Introduction....75
- Common Suffixes....80
- Activating Multi-Carrier Group Delay Measurements....80
- Configuring Multi-Carrier Group Delay Measurements....84
- Measuring, Loading and Storing Calibration Data....108
- Configuring the Result Display....109
- Configuring and Performing Sweeps....116
- Retrieving Results....122
- Analyzing Multi-Carrier Group Delay Measurements....127
- Commands for Compatibility....141

11.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, in most cases, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, these are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S FSW.

Remote command examples

Note that some remote command examples mentioned in this general introduction may not be supported by this particular application.

11.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitely.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSW follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

11.1.2 Long and Short Form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in upper case letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

11.1.3 Numeric Suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

11.1.4 Optional Keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

Note that if an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

11.1.5 Alternative Keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

11.1.6 SCPI Parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, these are separated by a comma.

Example:

```
LAYout:ADD:WINDow Spectrum,LEFT,MTABle
```

Parameters may have different forms of values.

- Numeric Values....78
- Boolean....79
- Character Data....79
- Character Strings....80
- Block Data....80

11.1.6.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

with unit: `SENSe:FREQuency:CENTer 1GHZ`

without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. in case of discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.
- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

In some cases, numeric values may be returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN
  Not a number. Represents the numeric value 9.91E37. NAN is returned in case of errors.

11.1.6.2 Boolean

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0.

Querying boolean parameters

When you query boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return `1`

11.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see chapter 11.1.2, "Long and Short Form", on page 76.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

11.1.6.4 Character Strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

```
INSTRument:DELete 'Spectrum'
```

11.1.6.5 Block Data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

11.2 Common Suffixes

In the Multi-Carrier Group Delay application, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<m>	1..16	Marker
<n>	1..6	Window
<t>	1..4	Trace

11.3 Activating Multi-Carrier Group Delay Measurements

Multi-Carrier Group Delay measurements requires a special application on the R&S FSW. A measurement is started immediately with the default settings.

INSTrument:CREate:DUPLicate....81
INSTrument:CREate[:NEW]....81
INSTrument:CREate:REPLace....81
INSTrument:DELete....82
INSTrument:LIST?....82
INSTrument:REName....83
INSTrument[:SELect]....83
SYSTem:PRESet:CHANnel[:EXECute]....84

INSTrument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e starts a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "Spectrum" -> "Spectrum 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

This command is not available if the MSRA Master channel is selected.

Example:
```
INST:SEL 'Spectrum'
INST:CRE:DUPL
```
Duplicates the channel named 'Spectrum' and creates a new measurement channel named 'Spectrum 2'.

Usage: Event

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 11-1.

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see table 11-1).

Example:
```
INST:CRE SAN, 'Spectrum 2'
```
Adds an additional spectrum display named "Spectrum 2".

INSTrument:CREate:REPLace <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a measurement channel with another one.

Parameters:

<ChannelName1> String containing the name of the measurement channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 11-1.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see table 11-1).

Example: `INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'`
Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

INSTrument:DELete <ChannelName>

This command deletes a measurement channel. If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

<ChannelName> String containing the name of the channel you want to delete.
A measurement channel must exist in order to be able delete it.

Example: `INST:DEL 'Spectrum4'`
Deletes the spectrum channel with the name 'Spectrum4'.

INSTrument:LIST?

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see table 11-1).
Tip: to change the channel name, use the `INSTrument:REName` command.

Example: `INST:LIST?`
Result for 3 measurement channels:
`'ADEM','Analog Demod','IQ','IQ Analyzer','SANALYZER','Spectrum'`

Usage: Query only

Table 11-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> Parameter	Default Channel Name*)
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:RENAme <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'Spectrum2','Spectrum3'`
Renames the channel with the name 'Spectrum2' to 'Spectrum3'.

INSTrument[:SELect] <ChannelType> | <ChannelName>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

See also `INSTrument:CREate[:NEW]` on page 81.

Parameters:

<ChannelType> **MCGD**
Multi-Carrier Group Delay application, R&S FSW-K17
For a list of available channel types see table 11-1.

<ChannelName> String containing the name of the channel.

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 26

11.4 Configuring Multi-Carrier Group Delay Measurements

The commands required to configure a Multi-Carrier Group Delay measurement in a remote environment are described here.

- RF Input....84
- Configuring the Vertical Axis (Amplitude, Scaling)....86
- Frequency....93
- Triggering Measurements....95
- Multi-Carrier Configuration....102
- Configuring the Outputs....105
- Automatic Settings....106

11.4.1 RF Input

INPut:ATTenuation:PROTection:RESet....85
INPut:COUPling....85
INPut:FILTer:HPASs[:STATe]....85
INPut:FILTer:YIG[:STATe]....85
INPut:IMPedance....86
INPut:SELect....86

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occured and the protection mechanism intervened.The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

(For details on the status register see the R&S FSW User Manual).

The command works only if the overload condition has been eliminated first.

Usage: Event

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType> **AC**
AC coupling
DC
DC coupling
*RST: AC

Example: `INP:COUP:DC`

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 28

INPut:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires option R&S FSW-B13.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG filter.)

Parameters:

<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 28

INPut:FILTer:YIG[:STATe] <State>

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 28.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 (0 for I/Q Analyzer, GSM, VSA and MC Group Delay measurements)

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 28

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Parameters:

<Impedance> 50 | 75

*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "Impedance" on page 28

INPut:SELect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW. If no additional options are installed, only RF input is supported.

Parameters:

<Source> **RF**
Radio Frequency ("RF INPUT" connector)

*RST: RF

11.4.2 Configuring the Vertical Axis (Amplitude, Scaling)

The following commands are required to configure the amplitude and vertical axis settings in a remote environment.

- Amplitude Settings....87
- Attenuation....87
- Configuring a Preamplifier....89
- Scaling the Y-Axis (+Units)....90

11.4.2.1 Amplitude Settings

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel....87
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet....87

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level.

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

Example:
```
DISP:TRAC:Y:RLEV -60dBm
```

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 30

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset.

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB

Example:
```
DISP:TRAC:Y:RLEV:OFFS -10dB
```

Manual operation: See "Reference Level" on page 30
See "Shifting the Display (Offset)" on page 30

11.4.2.2 Attenuation

INPut:ATTenuation....87
INPut:ATTenuation:AUTO....88
INPut:EATT....88
INPut:EATT:AUTO....89
INPut:EATT:STATe....89

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 89).

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>
Range: see data sheet
Increment: 5 dB
*RST: 10 dB (AUTO is set to ON)

Example: `INP:ATT 30dB`
Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Usage: SCPI confirmed

Manual operation: See "RF Attenuation" on page 31
See "Attenuation Mode / Value" on page 31

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Parameters:

<State>
ON | OFF | 0 | 1
*RST: 1

Example: `INP:ATT:AUTO ON`
Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual operation: See "RF Attenuation" on page 31
See "Attenuation Mode / Value" on page 31

INPut:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 89).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>
attenuation in dB
Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example:
```
INP:EATT:AUTO OFF
INP:EATT 10 dB
```

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 31

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 31

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `INP:EATT:STAT ON`
Switches the electronic attenuator into the signal path.

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 31

11.4.2.3 Configuring a Preamplifier

INPut:GAIN:STATe....89
INPut:GAIN[:VALue]....90

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Input Settings" on page 32
See "Preamplifier (option B24)" on page 32

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 89).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.
- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

All other values are rounded to the nearest of these two.

*RST: OFF

Example: `INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Input Settings" on page 32
See "Preamplifier (option B24)" on page 32

11.4.2.4 Scaling the Y-Axis (+Units)

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe] 90
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum 90
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum 91
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE 91
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision 92
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition 92
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue 92
DISPlay[:WINDow<n>]:TRACe:Y:SPACing 93
UNIT:ANGLe 93

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe] <Range>

This command defines the display range of the y-axis.

Example: `DISP:TRAC:Y 110dB`

Usage: SCPI confirmed

Manual operation: See "Defining a Range and the Reference Level Position" on page 34
See "Range" on page 34

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for the selected result display.

Parameters:

<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:
```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Defining Min and Max Values" on page 35

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for the selected result display.

Parameters:

<Value> <numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:
```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```
Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Defining Min and Max Values" on page 35

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE <Mode>

This command selects the type of scaling of the y-axis.

When the display update during remote control is off, this command has no immediate effect.

Parameters:

<Mode> **ABSolute**
absolute scaling of the y-axis

RELative
relative scaling of the y-axis

*RST: ABSolute

Example:
```
DISP:TRAC:Y:MODE REL
```

Manual operation: See "Defining a Range and the Reference Level Position" on page 34
See "Scaling" on page 34
See "Scale Mode" on page 35

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

Parameters:

<Value> numeric value; the unit depends on the result display

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`

Sets the grid spacing to 10 units (e.g. dB) per division

Manual operation: See "Configuring a Reference Point and Divisions" on page 34
See "Range per Division" on page 35

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

For measurements with the external generator (R&S FSW-B10) the command defines the position of the reference value.

Example: `DISP:TRAC:Y:RPOS 50PCT`

Usage: SCPI confirmed

Manual operation: See "Defining a Range and the Reference Level Position" on page 34
See "Ref Level Position" on page 34
See "Configuring a Reference Point and Divisions" on page 34
See "Y-Axis Reference Position" on page 35

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue <Value>

The command defines the power value assigned to the reference position in the grid.

For external generator calibration measurements (requires External Generator Control option R&S FSW-B10), this command defines the power offset value assigned to the reference position.

Parameters:

<Value> *RST: 0 dBm, coupled to reference level

Example: `DISP:TRAC:Y:RVAL -20dBm`

Sets the power value assigned to the reference position to -20 dBm

Manual operation: See "Configuring a Reference Point and Divisions" on page 34
See "Y-Axis Reference Value" on page 34

DISPlay[:WINDow<n>]:TRACe:Y:SPACing <ScalingType>

This command selects the scaling of the y-axis.

Parameters:

<ScalingType>

LOGarithmic
Logarithmic scaling.

LINear
Linear scaling in %.

LDB
Linear scaling in the specified unit.

PERCent
Linear scaling in %.

*RST: LOGarithmic

Example: `DISP:TRAC:Y:SPAC LIN`
Selects linear scaling in %.

Usage: SCPI confirmed

Manual operation: See "Defining a Range and the Reference Level Position" on page 34
See "Scaling" on page 34

UNIT:ANGLe <Unit>

This command selects the unit for angles (for phase display).

Parameters:

<Unit> DEG | RAD

*RST: DEG

Example: `UNIT:ANGL DEG`

Manual operation: See "Phase Unit (Rad/Deg)" on page 36

11.4.3 Frequency

[SENSe:]FREQuency:CENTer....93
[SENSe:]FREQuency:CENTer:STEP....94
[SENSe:]FREQuency:CENTer:STEP:AUTO....94
[SENSe:]FREQuency:CENTer:STEP:LINK....95
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor....95
[SENSe:]FREQuency:OFFSet....95

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

<Frequency> The allowed range and f_{max} is specified in the data sheet.

UP
Increases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

DOWN
Decreases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

*RST: fmax/2
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Usage: SCPI confirmed

Manual operation: See "Center" on page 37

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` AND `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer` on page 93.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency Stepsize" on page 37

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example:
```
FREQ:CENT:STEP:AUTO ON
```
Activates the coupling of the step size to the span.

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingType>

This command couples and decouples the center frequency step size to the span or the resolution bandwidth.

Parameters:

<CouplingType>

SPAN
Couples the step size to the span. Available for measurements in the frequency domain.

OFF
Decouples the step size.

*RST: SPAN

Example: `FREQ:CENT:STEP:LINK SPAN`

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <Factor>

This command defines a step size factor if the center frequency step size is coupled to the span.

Parameters:

<Factor>

1 to 100 PCT

*RST: 10

Example: `FREQ:CENT:STEP:LINK:FACT 20PCT`

[SENSe:]FREQuency:OFFSet <Offset>

This command defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

See also "Frequency Offset" on page 37.

Parameters:

<Offset>

Range: -100 GHz to 100 GHz
*RST: 0 Hz

Example: `FREQ:OFFS 1GHZ`

Usage: SCPI confirmed

Manual operation: See "Frequency Offset" on page 37

11.4.4 Triggering Measurements

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 93

Remote commands exclusive to triggering:

- Configuring the Triggering Conditions....96
- Configuring the Trigger Output....100

11.4.4.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe....96
TRIGger[:SEQuence]:HOLDoff[:TIME]....96
TRIGger[:SEQuence]:IFPower:HOLDoff....96
TRIGger[:SEQuence]:IFPower:HYSTeresis....97
TRIGger[:SEQuence]:LEVel[:EXTernal<port>]....97
TRIGger[:SEQuence]:LEVel:IFPower....98
TRIGger[:SEQuence]:LEVel:IQPower....98
TRIGger[:SEQuence]:LEVel:RFPower....98
TRIGger[:SEQuence]:RFPower:HOLDoff....98
TRIGger[:SEQuence]:SLOPe....99
TRIGger[:SEQuence]:SOURce....99

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s

Manual operation: See "Trigger Source" on page 39
See "Drop-Out Time" on page 41

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the sweep (data capturing).

Parameters:

<Offset> *RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Source" on page 39
See "Trigger Offset" on page 41

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

Parameters:
<Period> *RST: 150 ns

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Source" on page 39
See "Trigger Holdoff" on page 41

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:
<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Trigger Source" on page 39
See "Hysteresis" on page 41

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Note that the variable INPUT/OUTPUT connectors (ports 2+3) must be set for use as input using the `OUTPut:TRIGger<port>:DIRection` command.

Suffix:
<port> 1 | 2 | 3
Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:
<TriggerLevel> Range: 0.5 V to 3.5 V
*RST: 1.4 V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Source" on page 39
See "Trigger Level" on page 41

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -50 dBm to 20 dBm
*RST: -20 dBm

Example: `TRIG:LEV:IFP -30DBM`

Manual operation: See "Trigger Source" on page 39
See "Trigger Level" on page 41

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm

Example: `TRIG:LEV:IQP -30DBM`

Manual operation: See "Trigger Source" on page 39
See "Trigger Level" on page 41

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> Range: -50 dBm to -10 dBm
*RST: -20 dBm

Example: `TRIG:LEV:RFP -30dBm`

TRIGger[:SEQuence]:RFPower:HOLDoff <Time>

This command defines the holding time before the next trigger event. Note that this command is available for any trigger source, not just RF Power.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 96 command for new remote control programs.

Parameters:
<Time> Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

For all trigger sources except time you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:
<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Trigger Source" on page 39
See "Slope" on page 42

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.
Note: Connector must be configured for "Input".

RFPower
First intermediate frequency

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See "Trigger Source" on page 39
See "Trigger Source" on page 39
See "Free Run" on page 39
See "External Trigger 1/2/3" on page 39
See "IF Power" on page 40
See "RF Power" on page 40
See "IQ Power" on page 40

11.4.4.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 42.

OUTPut:TRIGger<port>:DIRection....100
OUTPut:TRIGger<port>:LEVel....101
OUTPut:TRIGger<port>:OTYPe....101
OUTPut:TRIGger<port>:PULSe:IMMediate....102
OUTPut:TRIGger<port>:PULSe:LENGth....102

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Direction> **INPut**
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 42

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with `OUTPut:TRIGger<port>:OTYPe`.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Level> **HIGH**
TTL signal.

LOW
0 V

*RST: LOW

Manual operation: See "Trigger 2/3" on page 42
See "Output Type" on page 42
See "Level" on page 42

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<OutputType>

DEVice
Sends a trigger signal when the R&S FSW has triggered internally.

TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
Sends a user defined trigger signal. For more information see `OUTPut:TRIGger<port>:LEVel`.

*RST: DEVice

Manual operation: See "Trigger 2/3" on page 42
See "Output Type" on page 42

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Usage: Event

Manual operation: See "Trigger 2/3" on page 42
See "Output Type" on page 42
See "Send Trigger" on page 43

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Length>

Pulse length in seconds.

Manual operation: See "Trigger 2/3" on page 42
See "Output Type" on page 42
See "Pulse Length" on page 42

11.4.5 Multi-Carrier Configuration

The following commands are required to configure the multi-carrier measurement.

CALCulate:GRPDelay:MODE....103
[SENSe:]BANDwidth:DEMod?....103
[SENSe:]BWIDth:DEMod?....103
[SENSe:]CARRier:COUNt....103
[SENSe:]CARRier:SPACing....103
[SENSe:]FREQuency:SPAN....104
[SENSe:]MTIMe:AUTO....104
[SENSe:]MTIMe?....104
[SENSe:]CARRier:OFFSet?....104
[SENSe:]CARRier:OFFSet:MODE....105
[SENSe:]RLENgth?....105
[SENSe:]SRATe?....105

CALCulate:GRPDelay:MODE <GroupDelayAbsRel>

This command sets the group delay mode for multi carriers to either absolute or relative or queries its current state.

Parameters:
<GroupDelayAbsRel> ABSolute | RELative

ABSolute
Calculates the absolute group delay; requires an external trigger

RELative
Calculates the relative group delay; constant delay parts are compensated for

*RST: ABSolute

Manual operation: See "Group Delay Mode" on page 46

[SENSe:]BANDwidth:DEMod?
[SENSe:]BWIDth:DEMod?

Queries the measurement bandwidth in Hz

Return values:
<Bandwidth> Default unit: HZ

Usage: Query only

[SENSe:]CARRier:COUNt <Count>

Sets/queries the number of carriers.

Parameters:
<Count>

Manual operation: See "Number of Carriers" on page 45

[SENSe:]CARRier:SPACing <CarrierSpacing>

Sets/queries the carrier spacing in Hz between the multiple carriers.

Parameters:
<CarrierSpacing> Default unit: HZ

Manual operation: See "Carrier Spacing" on page 45

[SENSe:]FREQuency:SPAN <Frequency>

Sets/queries the frequency span in Hz

Parameters:
<Frequency> Default unit: HZ

Manual operation: See "Span" on page 37

[SENSe:]MTIMe:AUTO <MeasTimeAutoMode>

This command enables or disables automatic measurement time selection.

Parameters:
<MeasTimeAutoMode> **ON | 1**
Enables automatic measurement time selection.

OFF | 0
Measurement time is defined manually.

*RST: 1

Manual operation: See "Measurement Time" on page 45

[SENSe:]MTIMe? <MeasTime>

This command queries or sets the measurement time.

Parameters:
<MeasTime> The measurement time.

*RST: 5 ms
Default unit: S

Usage: Query only

Manual operation: See "Measurement Time" on page 45

[SENSe:]CARRier:OFFSet?

Queries the offset in Hz of the carriers compared to the center frequency.

Return values:
<CarrierOffset> Range: - (Carrier spacing / 2) to + (Carrier spacing / 2)
Default unit: HZ

Usage: Query only

Manual operation: See "Carrier Offset" on page 46

[SENSe:]CARRier:OFFSet:MODE <CarrierOffsetMode>

This command determines how the carrier offset is defined.

Parameters:

<CarrierOffsetMode> ESTimate | FIXed

ESTimate
The offset is estimated from the measurement data and compensated for automatically.
Possible values are in the range of:
- (Carrier spacing / 2) to + (Carrier spacing / 2)

FIXed
A fixed offset is used, depending on the number of carriers:
Odd number: offset = 0
Even number: ofset = Carrier spacing / 2

Manual operation: See "Carrier Offset" on page 46

[SENSe:]RLENgth?

This command returns the record length determined by the current measurement settings.

Return values:

<SampleCount> Number of samples captured in one sweep.

Usage: Query only

[SENSe:]SRATe?

This command returns the sample rate set up for current measurement settings.

Return values:

<SampleRate> Current sample rate used by the application.

Usage: Query only

11.4.6 Configuring the Outputs

Configuring trigger input/output is described in chapter 11.4.4.2, "Configuring the Trigger Output", on page 100.

DIAGnostic:SERVice:NSOurce.....105

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the front panel on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 50

11.4.7 Automatic Settings

Some settings can be adjusted by the R&S FSW automatically according to the current measurement settings and signal characteristics.

MSRA operating mode

In MSRA operating mode, the following automatic settings are not available, as they require a new data acquisition. However, the GSM application cannot perform data acquisition in MSRA operating mode.

[SENSe:]ADJust:CONFigure:DURation....106
[SENSe:]ADJust:CONFigure:DURation:MODE....106
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer....107
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer....107
[SENSe:]ADJust:LEVel....108

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 52

[SENSe:]ADJust:CONFigure:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command selects the way the R&S FSW determines the length of the measurement .

Parameters:

<Mode>

AUTO
The R&S FSW determines the measurement length automatically according to the current input data.

MANual
The R&S FSW uses the measurement length defined by `[SENSe:]ADJust:CONFigure:DURation` on page 106.

*RST: AUTO

Manual operation: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 52
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 52

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 108 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example:
```
SENS:ADJ:CONF:HYST:LOW 2
```
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "Lower Level Hysteresis" on page 53

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 108 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example:
```
SENS:ADJ:CONF:HYST:UPP 2
```

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "Upper Level Hysteresis" on page 52

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

Usage: Event

Manual operation: See "Setting the Reference Level Automatically (Auto Level)" on page 52

11.5 Measuring, Loading and Storing Calibration Data

The folowing commands are required to perform the calibration measurement and load and store the calibration data.

CALibration:MCGD....108
CALibration:MCGD:STATe?....108
MMEMory:LOAD:MCGD:RCALibration....109
MMEMory:STORe:MCGD:RCALibration....109

CALibration:MCGD

This command initiates a new calibration. You can synchronize to the end of the measurement as usual with *OPC, *OPC? or *WAI.

Example: `CAL:MCGD;*WAI`
Performs a calibration measurement and waits for the results.

Usage: Event

Manual operation: See "Calibrate (Execute Reference Calibration)" on page 47

CALibration:MCGD:STATe?

This command queries the calibration status of the Multi Carrier Group Delay application.

Return values:

<State> **ON | 1**
Calibration has been performed, reference data is available.

OFF | 0
Calibration has not yet been performed or is currently running, reference data is not yet available.

Usage: Query only

MMEMory:LOAD:MCGD:RCALibration <File>

This command loads the calibration data stored in the selected file and replaces the current data.

Setting parameters:

<File> path and file name of the `.csv` file that contains the calibration data

Usage: Setting only

Manual operation: See "Loading Calibration Data" on page 48

MMEMory:STORe:MCGD:RCALibration <File>

This command stores the current calibration data to the selected file.

Setting parameters:

<File> path and file name of the `.csv` file that will contain the calibration data

Usage: Setting only

Manual operation: See "Storing Calibration Data" on page 47

11.6 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

- General Window Commands.....109
- Working with Windows in the Display.....110

11.6.1 General Window Commands

The following commands are required to configure general window layout, independant of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see INSTrument[:SELect] on page 83).

DISPlay:FORMat....110
DISPlay[:WINDow<n>]:SIZE....110

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SPL

Example: DISP:FORM SING

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the LAY:SPL command (see LAYout:SPLitter on page 113).

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: DISP:WIND2:LARG

11.6.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see INSTrument[:SELect] on page 83).

LAYout:ADD[:WINDow]?....111
LAYout:CATalog[:WINDow]?....112
LAYout:IDENtify[:WINDow]?....112

LAYout:REMove[:WINDow]....113
LAYout:REPLace[:WINDow]....113
LAYout:SPLitter....113
LAYout:WINDow<n>:ADD?....115
LAYout:WINDow<n>:IDENtify?....115
LAYout:WINDow<n>:REMove....115
LAYout:WINDow<n>:REPLace....116

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:
```
LAY:ADD? '1',LEFT,MTAB
```
Result:
```
'2'
```
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation:
See "Magnitude" on page 15
See "Phase" on page 16
See "Magnitude Reference" on page 16
See "Phase Reference" on page 17
See "Group Delay" on page 17
See "Gain" on page 18
See "Marker Table" on page 18

Table 11-2: <WindowType> parameter values for Multi-Carrier Group Delay (K17) application

Parameter value	Window type
GAIN	Gain
GDELay	Group Delay vs. Frequency
MAGNitude	Magnitude vs. Frequency (Measurement data)
MTABle	Marker table
PHASe	Phase vs Frequency (Measurement data)
RMAGnitude	Magnitude vs. Frequency (Reference data)
RPHase	Phase vs Frequency (Reference data)

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 111 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

LAYout:SPLitter <Index1>,<Index2>,<Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

As opposed to the `DISPlay[:WINDow<n>]:SIZE` on page 110 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command will not work, but does not return an error.

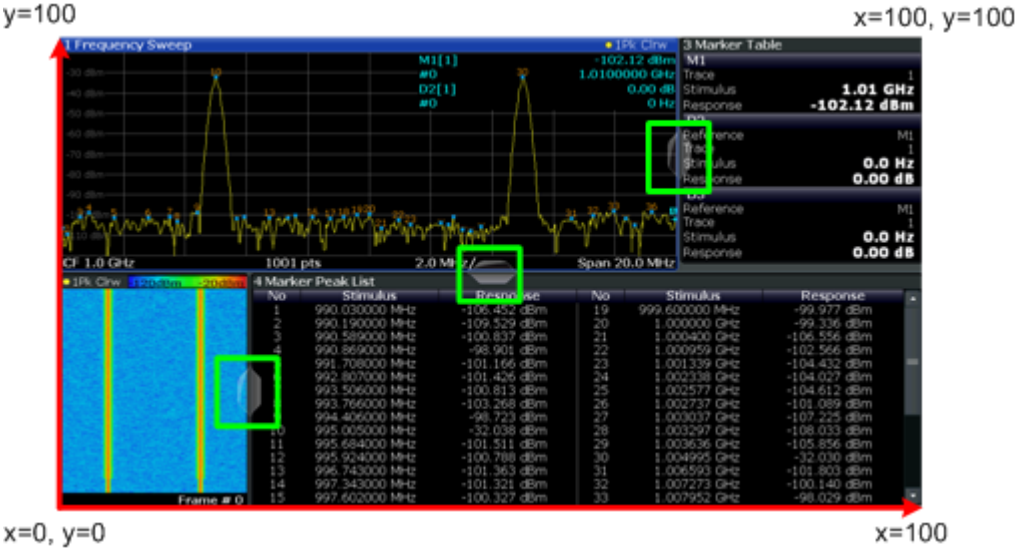


Fig. 11-1: SmartGrid coordinates for remote control of the splitters

Parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu). The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See figure 11-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example:
```
LAY:SPL 1,3,50
```
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Table') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example:
```
LAY:SPL 1,4,70
```
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('Marker Peak List') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
```
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70
```

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 111 for a list of available window types.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

```
LAY:WIND1:ADD? LEFT,MTAB
Result:
'2'
```

Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix).

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 111 for a list of available window types.

11.7 Configuring and Performing Sweeps

When the MCGD application is activated, a continuous sweep is performed automatically. However, you can stop and start a new measurement any time.

Furthermore, you can perform a sequence of measurements using the Sequencer (see "Multiple Measurement Channels and Sequencer Function" on page 10).

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]AVERage:COUNt` on page 129

Remote commands exclusive to

ABORt....116
INITiate:CONMeas....117
INITiate:CONTinuous....118
INITiate[:IMMediate]....118
INITiate:SEQuencer:ABORt....119
INITiate:SEQuencer:IMMediate....119
INITiate:SEQuencer:MODE....120
SYSTem:SEQuencer....120
[SENSe:]SWEep:COUNt....121
[SENSe:]SWEep:COUNt:CURRent?....122

ABORt

This command aborts a current measurement and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` on page 119 command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: SCPI confirmed

INITiate:CONMeas

This command restarts a (single) measurement that has been stopped (using `INIT:CONT OFF`) or finished in single sweep mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate[:IMMediate]`, this command does not reset traces in maxhold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Example: (for Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.
`INIT:CONM;*WAI`
Continues the measurement (next 20 sweeps) and waits for the end.
Result: Averaging is performed over 40 sweeps.

Manual operation: See "Continue Single Sweep" on page 49

INITiate:CONTinuous <State>

This command controls the sweep mode.

Note that in single sweep mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous sweep mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous sweep mode in remote control, as results like trace data or markers are only valid after a single sweep end synchronization.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 119) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Continuous sweep

OFF | 0
Single sweep

*RST: 1

Example: `INIT:CONT OFF`
Switches the sweep mode to single sweep.
`INIT:CONT ON`
Switches the sweep mode to continuous sweep.

Manual operation: See "Continuous Sweep/RUN CONT" on page 48

INITiate[:IMMediate]

This command starts a (single) new measurement.

With sweep count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Example: (For Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Sets the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.

Manual operation: See "Single Sweep/ RUN SINGLE" on page 48

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate:SEQuencer:IMMediate` on page 119.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 120.

Usage: Event

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the `INITiate[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 120).

Example:
`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Usage: Event

INITiate:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 120).

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example:

```
SYST:SEQ ON
```
Activates the Sequencer.
```
INIT:SEQ:MODE SING
```
Sets single sequence mode so each active measurement will be performed once.
```
INIT:SEQ:IMM
```
Starts the sequential measurements.

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error will occur.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:
```
SYST:SEQ ON
```
Activates the Sequencer.
```
INIT:SEQ:MODE SING
```
Sets single Sequencer mode so each active measurement will be performed once.
```
INIT:SEQ:IMM
```
Starts the sequential measurements.
```
SYST:SEQ OFF
```

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps the R&S FSW uses to average traces.

During calibration measurements, the phase and amplitude values are averaged over the defined number of sweeps.

In case of continuous sweeps, the R&S FSW calculates the moving average over the average count.

In case of single sweep measurements, the R&S FSW stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> If you set a sweep count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the sweep count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 32767
*RST: 0

Example:
```
SWE:COUN 64
```
Sets the number of sweeps to 64.
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.

Usage: SCPI confirmed

Manual operation: See "Sweep Count" on page 45

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Example:
```
SWE:COUNt 64
```
Sets sweep count to 64
```
INIT:CONT OFF
```
Switches to single sweep mode
```
INIT
```
Starts a sweep (without waiting for the sweep end!)
```
SWE:COUN:CURR?
```
Queries the number of started sweeps

Usage: Query only

11.8 Retrieving Results

The following commands are required to retrieve the results in a remote environment.

- Retrieving Marker Results....122
- Retrieving Trace Results....124
- Exporting Trace Results....125

11.8.1 Retrieving Marker Results

Useful commands for retrieving results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 132
- `CALCulate<n>:MARKer<m>:X` on page 134

Remote commands exclusive to retrieving marker results:

CALCulate<n>:DELTamarker<m>:X:RELative?....122
CALCulate<n>:DELTamarker<m>:Y?....123
CALCulate<n>:MARKer<m>:Y?....123

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:
```
CALC:DELT3:X:REL?
```
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also `INITiate:CONTinuous` on page 118.

The unit depends on the application of the command.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.
```
CALC:DELT2 ON
```
Switches on delta marker 2.
```
CALC:DELT2:Y?
```
Outputs measurement value of delta marker 2.

Usage: Query only

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps. See also `INITiate:CONTinuous` on page 118.

Return values:

<Result> Result at the marker position.

Example:
```
INIT:CONT OFF
```
Switches to single measurement mode.
```
CALC:MARK2 ON
```
Switches marker 2.
```
INIT;*WAI
```
Starts a measurement and waits for the end.
```
CALC:MARK2:Y?
```
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "Marker Table" on page 18

11.8.2 Retrieving Trace Results

The following remote commands are required to retrieve the trace results in a remote environment.

DISPlay[:WINDow<n>]:TRACe<t>:LENGth?....124
FORMat[:DATA]....124
MMEMory:STORe:MCGD:MEAS....124
TRACe<n>[:DATA]?....125
TRACe<n>[:DATA]:X?....125

DISPlay[:WINDow<n>]:TRACe<t>:LENGth?

Queries the trace length.

Return values:

<TraceLength> Number of trace points

Usage: Query only

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example:
```
FORM REAL,32
```

Usage: SCPI confirmed

MMEMory:STORe:MCGD:MEAS <File>

This command stores the current measurement results (all active traces in all windows, including calibration traces) to the selected file.

Setting parameters:

<File> path and file name of the `.csv` file that contains the measured data

Usage: Setting only

Manual operation: See "Storing Measurement Results" on page 68

TRACe<n>[:DATA]? <Trace>

This command queries current trace data and measurement results for the specified window. For each of the measurement points (number is determined by record length, see `[SENSe:]RLENgth?` on page 105) the power level, phase or group delay value is returned.

Query parameters:

<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4

Defines the trace whose data is returned.

Example: TRAC3:DATA? TRACE1

Returns the measured values for trace 1 in window 3.

Usage: Query only

TRACe<n>[:DATA]:X? <TraceNumber>

This command queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements. This is especially useful for traces with non-equidistant x-values, e.g. for SEM or Spurious Emissions measurements.

Query parameters:

<TraceNumber> Trace number.

TRACE1 | ... | TRACE4

Example: `TRAC3:X? TRACE1`

Returns the x-values for trace 1 in window 3.

Usage: Query only

11.8.3 Exporting Trace Results

Trace results can be exported to a file.

For more commands concerning data and results storage see the R&S FSW User Manual.

MMEMory:STORe<n>:TRACe....126
FORMat:DEXPort:DSEParator....126
FORMat:DEXPort:HEADer....126
FORMat:DEXPort:TRACes....127

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

For details on the file format see chapter 12.2, "Reference: ASCII File Export Format", on page 147.

Parameters:

<Trace> Number of the trace to be stored
(This parameter is ignored if the option "Export all Traces and all Table Results" is activated in the Export configuration settings, see `FORMat:DEXPort:TRACes` on page 127).

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 3,'TEST.ASC'`
Stores trace 3 from window 1 in the file `TEST.ASC`.

Usage: SCPI confirmed

Manual operation: See "Export Trace to ASCII File" on page 58

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 48

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

See chapter 12.2, "Reference: ASCII File Export Format", on page 147 for details.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Usage: SCPI confirmed

Manual operation: See "Include Instrument Measurement Settings" on page 57

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 126).

Parameters:

<Selection>

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Usage: SCPI confirmed

Manual operation: See "Export all Traces and all Table Results" on page 57

11.9 Analyzing Multi-Carrier Group Delay Measurements

The following commands are required to analyze MCGD measurements in a remote environment.

- Configuring Standard Traces....127
- Setting Up Individual Markers....130
- General Marker Settings....134
- Searching for Peaks and Positioning the Marker....135
- Zooming into the Display....139

11.9.1 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- `DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 93
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]` on page 90

Remote commands exclusive to trace configuration

DISPlay[:WINDow<n>]:TRACe<t>:MODE....128
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous....128
DISPlay[:WINDow<n>]:TRACe<t>[:STATe]....129
[SENSe:]AVERage:COUNt....129
[SENSe:]AVERage<n>[:STATe<t>]....130
[SENSe:]AVERage<n>:TYPE....130

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with Sweep Count. Note that synchronization to the end of the measurement is possible only in single sweep mode.

Parameters:

<Mode>

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:

```
INIT:CONT OFF
```
Switching to single sweep mode.
```
SWE:COUN 16
```
Sets the number of measurements to 16.
```
DISP:TRAC3:MODE WRIT
```
Selects clear/write mode for trace 3.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Mode" on page 55

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:

<State>

ON
The automatic reset is off.

OFF
The automatic reset is on.

*RST: OFF

Example: `DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 55

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Parameters:

<State> ON | OFF | 0 | 1

*RST: Trace 1: 1, Trace 2-4: 0

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4" on page 55
See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 57

[SENSe:]AVERage:COUNt <AverageCount>

This command defines the number of sweeps that the application uses to average traces.

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<AverageCount> If you set an average count of 0 or 1, the application performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 32767
*RST: 0

Usage: SCPI confirmed

Manual operation: See "Average Count" on page 56

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:
<State> ON | OFF

Usage: SCPI confirmed

[SENSe:]AVERage<n>:TYPE <Mode>

This command selects the trace averaging mode.

Parameters:
<Mode>

VIDeo
The logarithmic power values are averaged.

LINear
The power values are averaged before they are converted to logarithmic values.

POWer
The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

*RST: VIDeo

Example: `AVER:TYPE LIN`
Switches to linear average calculation.

Usage: SCPI confirmed

Manual operation: See "Average Mode" on page 55

11.9.2 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:DELTamarker:AOFF....131
CALCulate<n>:DELTamarker<m>:LINK....131
CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>....131
CALCulate<n>:DELTamarker:MODE....131
CALCulate<n>:DELTamarker<m>:MREF....132
CALCulate<n>:DELTamarker<m>[:STATe]....132
CALCulate<n>:DELTamarker<m>:TRACe....132
CALCulate<n>:DELTamarker<m>:X....132
CALCulate<n>:MARKer<m>:AOFF....133
CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>....133
CALCulate<n>:MARKer<m>[:STATe]....133
CALCulate<n>:MARKer<m>:TRACe....134
CALCulate<n>:MARKer<m>:X....134

CALCulate<n>:DELTamarker:AOFF

This command turns all delta markers off.

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:DELT2:LINK ON`

Manual operation: See "Linking to Another Marker" on page 61

CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker" on page 61

CALCulate<n>:DELTamarker:MODE <Mode>

This command selects the delta marker mode.

Parameters:
<Mode> **ABSolute**
Delta marker position in absolute terms.
RELative
Delta marker position in relation to a reference marker.
*RST: RELative

Example: `CALC:DELT:MODE ABS`
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

Parameters:

<Reference> **1 to 16**
Selects markers 1 to 16 as the reference.

Example: `CALC:DELT3:MREF 2`
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 61

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker State" on page 60
See "Marker Type" on page 60

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:

<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis. The unit is s.

Example: `CALC:DELT:X?`
Outputs the (absolute) x-value of delta marker 1.

Manual operation: See "Marker Position (X-value)" on page 60

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 61

CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 61

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 60
See "Marker Type" on page 60

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:
<Trace>

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Manual operation: See "Assigning the Marker to a Trace" on page 61

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
The unit is s.
Range: The range depends on the current x-axis range.

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 18
See "Marker Position (X-value)" on page 60

11.9.3 General Marker Settings

The following commands control general marker functionality.

DISPlay:MTABle.....134
CALCulate<n>:MARKer<m>:LINK.....135

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>

ON
Turns the marker table on.

OFF
Turns the marker table off.

AUTO
Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 62

CALCulate<n>:MARKer<m>:LINK <State>

This command sets whether all markers will be linked across all display windows or queries the current setting.

Parameters:
<State>

Manual operation: See "Linked Markers" on page 62

11.9.4 Searching for Peaks and Positioning the Marker

The following remote commands are required to search for peaks and position the marker on a trace.

- Searching for Peaks....135
- Positioning Markers....136
- Positioning Delta Markers....138

11.9.4.1 Searching for Peaks

CALCulate<n>:MARKer:PEXCursion <Excursion>

This command defines the peak excursion.

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Application/Result display	Unit
Spectrum	dB
MCGD	dBm, DEG, RAD, S, MS, US, NS, PS, SC

Parameters:

<Excursion> The excursion is the distance to a trace maximum that must be attained before a new maximum is recognized, or the distance to a trace minimum that must be attained before a new minimum is recognized

Range: 0 to 80 dB (MCGD: 60 dBm)
*RST: 6.0

Manual operation: See "Peak Excursion" on page 64

11.9.4.2 Positioning Markers

The following commands position markers on the trace.

Useful commands for positioning markers described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 132

Remote commands exclusive to positioning markers

CALCulate<n>:MARKer<m>:MAXimum:LEFT....136
CALCulate<n>:MARKer<m>:MAXimum:NEXT....136
CALCulate<n>:MARKer<m>:MAXimum[:PEAK]....136
CALCulate<n>:MARKer<m>:MAXimum:RIGHt....137
CALCulate<n>:MARKer<m>:MINimum:LEFT....137
CALCulate<n>:MARKer<m>:MINimum:NEXT....137
CALCulate<n>:MARKer<m>:MINimum[:PEAK]....137
CALCulate<n>:MARKer<m>:MINimum:RIGHt....137

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63
See "Search Next Peak" on page 65

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 65

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63
See "Search Next Minimum" on page 65

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 65

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

11.9.4.3 Positioning Delta Markers

The following commands position delta markers on the trace.

Useful commands for positioning delta markers described elsewhere:

- `CALCulate<n>:MARKer<m>:X` on page 134

Remote commands exclusive to positioning delta markers

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT....138
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT....138
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]....138
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt....138
CALCulate<n>:DELTamarker<m>:MINimum:LEFT....139
CALCulate<n>:DELTamarker<m>:MINimum:NEXT....139
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]....139
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt....139

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63
See "Search Next Peak" on page 65

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 65

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63
See "Search Next Minimum" on page 65

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 65

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 63

11.9.5 Zooming into the Display

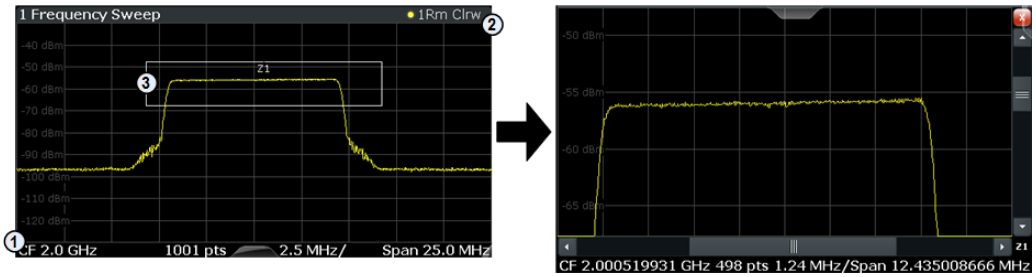
11.9.5.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA....139
DISPlay[:WINDow<n>]:ZOOM:STATe....140

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>, <x2>,<y2>
Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 66

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State>
ON | OFF
*RST: OFF

Example:
```
DISP:ZOOM ON
```
Activates the zoom mode.

Manual operation: See "Single Zoom" on page 66
See "Restore Original Display" on page 67
See "Deactivating Zoom (Selection mode)" on page 67

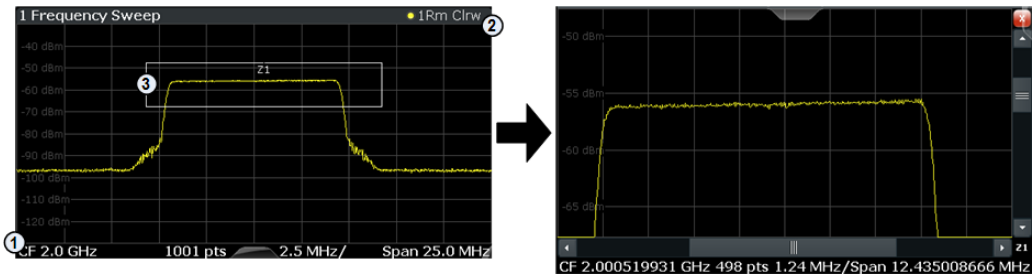
11.9.5.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....140
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....141

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:
<zoom> 1...4
Selects the zoom window.

Parameters:
<x1>,<y1>,
<x2>,<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Multiple Zoom" on page 66

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:
<zoom> 1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:
<State> ON | OFF

*RST: OFF

Manual operation: See "Multiple Zoom" on page 66
See "Restore Original Display" on page 67
See "Deactivating Zoom (Selection mode)" on page 67

11.10 Commands for Compatibility

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

To set the R&S FSW to compatible mode for previous signal analyzers, use the `SYST:LANG` command.

For details see the R&S FSW User Manual.

CALCulate<n>:FEED....142
DISPlay[:WINDow<n>]:TYPE....142
[SENSe:]ADEMod:BANDwidth:DEModulation?....143
[SENSe:]ADEMod:BWIDth:DEModulation?....143
[SENSe:]ADEMod:MCPHase:METHod....143
[SENSe:]ADEMod:MCPHase:SPACing....143
[SENSe:]ADEMod:MCPHase[:STATe]....144
[SENSe:]ADEMod:SPECtrum:PHASe:RESult?....144
[SENSe:]ADEMod:SPECtrum:PHASe:TYPE....144
[SENSe:]ADEMod:SPECtrum:SPAN....144
[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM....144
[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum]....145
[SENSe:]ADEMod:SPECtrum[:MAGNitude]:RESult?....145
[SENSe:]ADEMod:SPECtrum[:MAGNitude][:TYPE]....145
[SENSe:]ADEMod:MTIMe?....145
[SENSe:]ADEMod:MTIMe:AUTO....146
[SENSe:]ADEMod:RLENgth?....146
[SENSe:]ADEMod:SRATe?....146
[SENSe:]ADEMod[:STATe]....146

CALCulate<n>:FEED <Evaluation>

This command selects the evaluation method of the measured data that is to be displayed in the specified window.

This command queries or sets the diagram type (for magnitude or for phase).

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see chapter 11.6.2, "Working with Windows in the Display", on page 110).

Parameters:

<Evaluation>

'XFRequency:SPECtrum[:MAGNitude]'
Magnitude diagram

'XFRequency:SPECtrum:PHASe'
Phase diagram

DISPlay[:WINDow<n>]:TYPE <ResultType>

This command selects the results displayed in a measurement window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see chapter 11.6.2, "Working with Windows in the Display", on page 110).

Parameters:
<ResultType>

Table 11-3: <WindowType> parameter values for Multi-Carrier Group Delay (K17) mode

Parameter value	Window type
GAIN	Gain
GDELay	Group Delay
MAGNitude	Magnitude (Measurement data)
MTABle	Marker table
PHASe	Phase (Measurement data)
RMAGnitude	Magnitude (Reference data)
RPHase	Phase vs frequency (Reference data)

[SENSe:]ADEMod:BANDwidth:DEModulation?
[SENSe:]ADEMod:BWIDth:DEModulation?

This command queries the measurement bandwidth.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]BANDwidth:DEMod?` on page 103 for new remote control programs.

Return values:
<Span> Default unit: HZ

Usage: Query only

[SENSe:]ADEMod:MCPHase:METHod <Method>

This command selects the method used for group delay measurements. As the R&S FSW MCGD application only supports orthogonal measurements, this command returns an error if the FLATtop parameter is used.

Parameters:
<Method> ORTHogonal | FLATtop

[SENSe:]ADEMod:MCPHase:SPACing <CarrierSpacing>

Sets/queries the carrier spacing in Hz between the multiple carriers.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]CARRier:SPACing` on page 103 for new remote control programs.

Parameters:
<CarrierSpacing> Default unit: HZ

[SENSe:]ADEMod:MCPHase[:STATe] <State>

This command switches to the Multi Carrier Group Delay application of the instrument or disables it.

Note that this command is maintained for compatibility reasons only. Use the `INST:SEL MCGD` command for new remote control programs (see `INSTrument[:SELect]` on page 83).

Parameters:
<State>

[SENSe:]ADEMod:SPECtrum:PHASe:RESult? <WindowType>

This command returns the trace data of the first trace of the given type within the phase window.

Note that this command is maintained for compatibility reasons only. Use `TRACe<n>[:DATA]?` on page 125 for new remote control programs.

Query parameters:
<WindowType> WRITe | AVERage | MINHold | MAXHold

Usage: Query only

[SENSe:]ADEMod:SPECtrum:PHASe:TYPE <Trace1>, <Trace2>, <Trace3>

This command sets the modes of the first three traces of phase windows.

Note that this command is maintained for compatibility reasons only. Use `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 128 for new remote control programs.

Parameters:
<Trace1> WRITe | AVERage | MINHold | MAXHold | VIEW | OFF

<Trace2> WRITe | AVERage | MINHold | MAXHold | VIEW | OFF

<Trace3> WRITe | AVERage | MINHold | MAXHold | VIEW | OFF

[SENSe:]ADEMod:SPECtrum:SPAN <Frequency>

Sets/queries the frequency span in Hz.

Note that this command is maintained for compatibility reasons only. Use the `[SENSe:]FREQuency:SPAN` on page 104 command for new remote control programs.

Parameters:
<Frequency> Default unit: HZ

[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM <Value>

This command sets the span.

Note that this command is maintained for compatibility reasons only. Use [SENSe:]FREQuency:SPAN on page 104 for new remote control programs.

Parameters:
<Value> Default unit: HZ

[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] <Value>

This command sets the span.

Note that this command is maintained for compatibility reasons only. Use [SENSe:]FREQuency:SPAN on page 104 for new remote control programs.

Parameters:
<Value> Default unit: HZ

[SENSe:]ADEMod:SPECtrum[:MAGNitude]:RESult? <WindowType>

This command returns the trace data of the first trace of the given type within the magnitude window.

Note that this command is maintained for compatibility reasons only. Use TRACe<n>[:DATA]? on page 125 for new remote control programs.

Query parameters:
<WindowType> WRITe | AVERage | MINHold | MAXHold

Usage: Query only

[SENSe:]ADEMod:SPECtrum[:MAGNitude][:TYPE] <Trace1>, <Trace2>, <Trace3>

This command sets the modes of the first three traces of magnitude windows.

Note that this command is maintained for compatibility reasons only. Use DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 128 for new remote control programs.

Parameters:
<Trace1> WRITe | AVERage | MINHold | MAXHold | VIEW | OFF

<Trace2> WRITe | AVERage | MINHold | MAXHold | VIEW | OFF

<Trace3> WRITe | AVERage | MINHold | MAXHold | VIEW | OFF

[SENSe:]ADEMod:MTIMe? <MeasTime>

This command queries or sets the measurement time.

Note that this command is maintained for compatibility reasons only. Use [SENSe:]MTIMe? on page 104 for new remote control programs.

Parameters:
<MeasTime> Default unit: S

Usage: Query only

[SENSe:]ADEMod:MTIMe:AUTO <MeasTimeAutoMode>

This command enables or disables automatic measurement time selection.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]MTIMe:AUTO` on page 104 for new remote control programs.

Parameters:
<MeasTimeAutoMode>

[SENSe:]ADEMod:RLENgth?

This command returns the record length set up for current measurement settings.

Note that this command is maintained for compatibility reasons only. Use the `[SENSe:]RLENgth?` on page 105 command for new remote control programs.

Return values:
<SampleCount>

Usage: Query only

[SENSe:]ADEMod:SRATe?

This command returns the sample rate set up for current measurement settings.

Note that this command is maintained for compatibility reasons only. Use `[SENSe:]SRATe?` on page 105 for new remote control programs.

Return values:
<SampleRate>

Usage: Query only

[SENSe:]ADEMod[:STATe] <State>

This command switches to the Analog Demodulation application or disables it.

Note that this command is maintained for compatibility reasons only. Use the `INST:SEL ADEM` command for new remote control programs.

Parameters:
<State>

12 Annex

12.1 Formats for Returned Values: ASCII Format and Binary Format.....147
12.2 Reference: ASCII File Export Format.....147
12.3 Reference: CSV File Export Format.....149

12.1 Formats for Returned Values: ASCII Format and Binary Format

When trace data is retrieved using the `TRAC:DATA` or `TRAC:IQ:DATA` command, the data is returned in the format defined using the `FORMat[:DATA]`. The possible formats are described here.

- ASCII Format (FORMat ASCII):
  The data is stored as a list of comma separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,32):
  The data is stored as binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating-Point-Format.
  The schema of the result string is as follows:
  `#41024<value1><value2>…<value n>` with

#4	number of digits (= 4 in the example) of the following number of data bytes
1024	number of following data bytes (= 1024 in the example)
<Value>	4-byte floating point value

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

12.2 Reference: ASCII File Export Format

Trace data (both measurement and reference traces) can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling parameters and a data section containing the trace data.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see "Decimal Separator" on page 48).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section contains the measured data in two columns, which are also separated by a semicolon.

Table 12-1: ASCII file format for trace export

File contents	Description
Header data	
Type;R&S FSW;	Instrument model
Version;1.30;	Firmware version
Date;20.Jan 2012;	Date of data set storage
Mode;MCGD	Channel type
Ref Level;0;	Reference level
Level offset;0;	Reference level offset
Rf Att;10;	Input attenuation
El Att;0;	Electronic attentuation
Center Freq;10000000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;10000000;Hz	Frequency range
Carrier Spacing,10000000;Hz	Distance between two carriers
Meas Time;0.00003128125;s	Measurement time
Group Delay;Absolute;	Value type for group delay
Carrier Offset;AUTO;	Auto mode for carrier offset
Carrier Offset;0;Hz	Carrier offset value
Sweep Count;0;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Window;1 Magnitude;	Window name containing trace
Trace 1:;;	Selected trace
Trace Mode;Clear Write	Display mode of trace: CLR/WRITE,AVERAGE,MAX-HOLD,MINHOLD
x-Axis;Linear;	Scaling of x-axis linear (LIN) or logarithmic (LOG)
Start;95000000;Hz Stop;105000000;Hz	Start/stop value of the display range
x-Unit;Hz;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
y-Axis;Linear;	Scaling of y-axis linear (LIN) or logarithmic (LOG)
Level Range;100;dB	Display range in y direction. Unit: dB with x-axis LOG, % with x-axis LIN

File contents	Description
Ref Position;100; %	Position of reference value referred to diagram limits (0 % = lower edge)
Ref Value;0.0;dBm	Reference value
y-Unit;dBm;	Unit of y values: dB*/V/A/W depending on the selected unit with y-axis LOG or % with y-axis LIN
Data section	
Values; 1001;	Number of measurement points
95000000;-20.5 96000000;-20.3 97000000;-24.2 ...;...;	Measured values: <x value>, <y value>

12.3 Reference: CSV File Export Format

Measurement results and calibration data can be exported to a file in CSV format for further evaluation in other applications. Note that as opposed to the Export Trace to ASCII File, storing the measurement results in csv format includes all traces in all windows, not just one single trace.

The file consists of the header containing important parameters and a data section containing the measurement data.

Generally, the format of this CSV file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma; see "Decimal Separator" on page 48).

The data of the file header consist of three columns; each separated by a semicolon: parameter name; numeric value; basic unit. The data section contains the measured data in two columns, which are also separated by a semicolon.

Table 12-2: CSV file format for calibration data export

File contents	Description
Header data	
Type;R&S FSW-K17 Reference Calibration;	Type of data
Version;1.40;	Firmware version
Date;20.Jan 2012;	Date of data set storage
Mode;MCGD	Channel type
Center Freq;10000000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;10000000;Hz	Frequency range

File contents	Description
Number of Carriers;51;	Number of carriers
Carrier Spacing;10000000;Hz	Distance between two carriers
Meas Time;0.00003128125;s	Measurement time
Sweep Count;0	Sweep count
Trace type;Amplitude Reference Calibration	Data source and result display (Magnitude Reference)
x-Unit;Hz;	Unit of x values
y-Unit;V;	Unit of y values
Data section	
Values; 51;	Number of measurement points
95000000;-20.5 96000000;-20.3 97000000;-24.2 ...;...;	Measured values: <x value>; <y value>

Table 12-3: CSV file format for measurement data export

File contents	Description
Header data	
Type;R&S FSW;	Instrument model
Version;1.30;	Firmware version
Date;20.Jan 2012;	Date of data set storage
Mode;MCGD;DB1.00	Channel type; database version
Ref Level;0;	Reference level
Level offset;0;	Reference level offset
Rf Att;10;	Input attenuation
El Att;0;	Electronic attentuation
Center Freq;10000000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Span;10000000;Hz	Frequency range
Number of Carriers;51;	Number of carriers
Carrier Spacing;10000000;Hz	Distance between two carriers
Meas Time;0.00003128125;s	Measurement time
Group Delay;Absolute;	Value type for group delay
Carrier Offset;AUTO;	Auto mode for carrier offset
Carrier Offset;0;Hz	Carrier offset value
Sweep Count;0;	Number of sweeps set

File contents	Description
Preamplifier;OFF	Preamplifier status
Number of windows	Number of windows included in export
Data section for individual window	
Window;1 Magnitude	Name of first window (= result display)
Data section for individual trace	
Trace 1;;	First trace
Trace Mode;Clear Write;	Display mode of trace: CLR/WRITE;AVERAGE;MAX-HOLD;MINHOLD
x-Axis;Linear;	Scaling of x-axis: linear (LIN) or logarithmic (LOG)
Start;95000000;Hz Stop;105000000;Hz	Start/stop value of the display range
x-Unit;Hz;	Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements
y-Axis;Linear;	Scaling of y-axis linear (LIN) or logarithmic (LOG)
Level Range;100;dB	Display range in y direction. Unit: dB with x-axis LOG; % with x-axis LIN
Ref Position;100; %	Position of reference value referred to diagram limits (0 % = lower edge)
Ref Value;0.0;dBm	Reference value
y-Unit;dBm;	Unit of y values: dB*/V/A/W depending on the selected unit with y-axis LOG or % with y-axis LIN
Values; 1001;	Number of measurement points
95000000;-20.5 96000000;-20.3 97000000;-24.2 ...;...;	Measured values: <x value>; <y value>
Data section for individual trace	
Trace 2;;	Next trace in same window
...	
Data section for individual window	
Window;2 Phase;	Name of next window
Data section for individual trace	
Trace 1;;	First trace
...	

List of Remote Commands (MC Group Delay)

ABORt....116
CALCulate:GRPDelay:MODE....103
CALCulate<n>:DELTamarker:AOFF....131
CALCulate<n>:DELTamarker:MODE....131
CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>....131
CALCulate<n>:DELTamarker<m>:LINK....131
CALCulate<n>:DELTamarker<m>:MAXimum:LEFT....138
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT....138
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt....138
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]....138
CALCulate<n>:DELTamarker<m>:MINimum:LEFT....139
CALCulate<n>:DELTamarker<m>:MINimum:NEXT....139
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt....139
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]....139
CALCulate<n>:DELTamarker<m>:MREF....132
CALCulate<n>:DELTamarker<m>:TRACe....132
CALCulate<n>:DELTamarker<m>:X....132
CALCulate<n>:DELTamarker<m>:X:RELative?....122
CALCulate<n>:DELTamarker<m>:Y?....123
CALCulate<n>:DELTamarker<m>[:STATe]....132
CALCulate<n>:FEED....142
CALCulate<n>:MARKer:PEXCursion....135
CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>....133
CALCulate<n>:MARKer<m>:AOFF....133
CALCulate<n>:MARKer<m>:LINK....135
CALCulate<n>:MARKer<m>:MAXimum:LEFT....136
CALCulate<n>:MARKer<m>:MAXimum:NEXT....136
CALCulate<n>:MARKer<m>:MAXimum:RIGHt....137
CALCulate<n>:MARKer<m>:MAXimum[:PEAK]....136
CALCulate<n>:MARKer<m>:MINimum:LEFT....137
CALCulate<n>:MARKer<m>:MINimum:NEXT....137
CALCulate<n>:MARKer<m>:MINimum:RIGHt....137
CALCulate<n>:MARKer<m>:MINimum[:PEAK]....137
CALCulate<n>:MARKer<m>:TRACe....134
CALCulate<n>:MARKer<m>:X....134
CALCulate<n>:MARKer<m>:Y?....123
CALCulate<n>:MARKer<m>[:STATe]....133
CALibration:MCGD....108
CALibration:MCGD:STATe?....108
DIAGnostic:SERVice:NSOurce....105
DISPlay:FORMat....110
DISPlay:MTABle....134
DISPlay[:WINDow<n>]:SIZE....110
DISPlay[:WINDow<n>]:TRACe:Y:SPACing....93
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]....90

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MAXimum....90
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MINimum....91
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE....91
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:PDIVision....92
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel....87
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet....87
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition....92
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue....92
DISPlay[:WINDow<n>]:TRACe<t>:LENGth?....124
DISPlay[:WINDow<n>]:TRACe<t>:MODE....128
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous....128
DISPlay[:WINDow<n>]:TRACe<t>[:STATe]....129
DISPlay[:WINDow<n>]:TYPE....142
DISPlay[:WINDow<n>]:ZOOM:AREA....139
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA....140
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe....141
DISPlay[:WINDow<n>]:ZOOM:STATe....140
FORMat:DEXPort:DSEParator....126
FORMat:DEXPort:HEADer....126
FORMat:DEXPort:TRACes....127
FORMat[:DATA]....124
INITiate:CONMeas....117
INITiate:CONTinuous....118
INITiate:SEQuencer:ABORt....119
INITiate:SEQuencer:IMMediate....119
INITiate:SEQuencer:MODE....120
INITiate[:IMMediate]....118
INPut:ATTenuation....87
INPut:ATTenuation:AUTO....88
INPut:ATTenuation:PROTection:RESet....85
INPut:COUPling....85
INPut:EATT....88
INPut:EATT:AUTO....89
INPut:EATT:STATe....89
INPut:FILTer:HPASs[:STATe]....85
INPut:FILTer:YIG[:STATe]....85
INPut:GAIN:STATe....89
INPut:GAIN[:VALue]....90
INPut:IMPedance....86
INPut:SELect....86
INSTrument:CREate:DUPLicate....81
INSTrument:CREate:REPLace....81
INSTrument:CREate[:NEW]....81
INSTrument:DELete....82
INSTrument:LIST?....82
INSTrument:REName....83
INSTrument[:SELect]....83
LAYout:ADD[:WINDow]?....111

LAYout:CATalog[:WINDow]?....112
LAYout:IDENtify[:WINDow]?....112
LAYout:REMove[:WINDow]....113
LAYout:REPLace[:WINDow]....113
LAYout:SPLitter....113
LAYout:WINDow<n>:ADD?....115
LAYout:WINDow<n>:IDENtify?....115
LAYout:WINDow<n>:REMove....115
LAYout:WINDow<n>:REPLace....116
MMEMory:LOAD:MCGD:RCALibration....109
MMEMory:STORe:MCGD:MEAS....124
MMEMory:STORe:MCGD:RCALibration....109
MMEMory:STORe<n>:TRACe....126
OUTPut:TRIGger<port>:DIRection....100
OUTPut:TRIGger<port>:LEVel....101
OUTPut:TRIGger<port>:OTYPe....101
OUTPut:TRIGger<port>:PULSe:IMMediate....102
OUTPut:TRIGger<port>:PULSe:LENGth....102
SYSTem:PRESet:CHANnel[:EXECute]....84
SYSTem:SEQuencer....120
TRACe<n>[:DATA]:X?....125
TRACe<n>[:DATA]?....125
TRIGger[:SEQuence]:DTIMe....96
TRIGger[:SEQuence]:HOLDoff[:TIME]....96
TRIGger[:SEQuence]:IFPower:HOLDoff....96
TRIGger[:SEQuence]:IFPower:HYSTeresis....97
TRIGger[:SEQuence]:LEVel:IFPower....98
TRIGger[:SEQuence]:LEVel:IQPower....98
TRIGger[:SEQuence]:LEVel:RFPower....98
TRIGger[:SEQuence]:LEVel[:EXTernal<port>]....97
TRIGger[:SEQuence]:RFPower:HOLDoff....98
TRIGger[:SEQuence]:SLOPe....99
TRIGger[:SEQuence]:SOURce....99
UNIT:ANGLe....93
[SENSe:]ADEMod:BANDwidth:DEModulation?....143
[SENSe:]ADEMod:BWIDth:DEModulation?....143
[SENSe:]ADEMod:MCPHase:METHod....143
[SENSe:]ADEMod:MCPHase:SPACing....143
[SENSe:]ADEMod:MCPHase[:STATe]....144
[SENSe:]ADEMod:MTIMe:AUTO....146
[SENSe:]ADEMod:MTIMe?....145
[SENSe:]ADEMod:RLENgth?....146
[SENSe:]ADEMod:SPECtrum:PHASe:RESult?....144
[SENSe:]ADEMod:SPECtrum:PHASe:TYPE....144
[SENSe:]ADEMod:SPECtrum:SPAN....144
[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM....144
[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum]....145
[SENSe:]ADEMod:SPECtrum[:MAGNitude]:RESult?....145

[SENSe:]ADEMod:SPECtrum[:MAGNitude][:TYPE] 145
[SENSe:]ADEMod:SRATe? 146
[SENSe:]ADEMod[:STATe] 146
[SENSe:]ADJust:CONFigure:DURation 106
[SENSe:]ADJust:CONFigure:DURation:MODE 106
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer 107
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer 107
[SENSe:]ADJust:LEVel 108
[SENSe:]AVERage:COUNt 129
[SENSe:]AVERage<n>:TYPE 130
[SENSe:]AVERage<n>[:STATe<t>] 130
[SENSe:]BANDwidth:DEMod? 103
[SENSe:]BWIDth:DEMod? 103
[SENSe:]CARRier:COUNt 103
[SENSe:]CARRier:OFFSet:MODE 105
[SENSe:]CARRier:OFFSet? 104
[SENSe:]CARRier:SPACing 103
[SENSe:]FREQuency:CENTer 93
[SENSe:]FREQuency:CENTer:STEP 94
[SENSe:]FREQuency:CENTer:STEP:AUTO 94
[SENSe:]FREQuency:CENTer:STEP:LINK 95
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 95
[SENSe:]FREQuency:OFFSet 95
[SENSe:]FREQuency:SPAN 104
[SENSe:]MTIMe:AUTO 104
[SENSe:]MTIMe? 104
[SENSe:]RLENgth? 105
[SENSe:]SRATe? 105
[SENSe:]SWEep:COUNt 121
[SENSe:]SWEep:COUNt:CURRent? 122

Index

A

Aborting
Sweep ... 48, 49
Absolute group delay ... 21, 46
AC/DC coupling ... 28
Activating
MC Group Delay application (remote) ... 80
Amplitude
Configuration (softkey) ... 29
Scaling ... 34
Settings ... 29
Settings (remote) ... 87
Amplitude flatness
see Gain ... 20
Analysis
Button ... 54
Application
Multi-Carrier Group Delay ... 24
ASCII trace export ... 147
Attenuation ... 31
Auto ... 31
Displayed ... 11
Electronic ... 31
Manual ... 31
Option B25 ... 31
Protective (remote) ... 85
Settings (remote) ... 87
Auto level
Hysteresis ... 52, 53
Reference level ... 52
Softkey ... 52
Auto settings ... 51
Meastime Auto (softkey) ... 52
Meastime Manual (softkey) ... 52
Remote control ... 106
Average count ... 56
Average mode
Traces ... 55
Averaging
Results ... 21
Traces (remote control) ... 130

C

Calibration ... 22
Date and time ... 11
Error messages ... 74
Functions ... 46
Loading data ... 48, 69
Loading data (remote) ... 108
Measurement (remote) ... 108
Performing ... 47
Storing data ... 47, 68
Storing data (remote) ... 108
Troubleshooting ... 73
Carrier offset ... 21, 46
Carriers
Number ... 45
Carrier spacing ... 45
Center frequency ... 37, 44
Displayed ... 11
Softkey ... 37, 44
Step size ... 37
Continue single sweep
Softkey ... 49
Continuous sweep
Softkey ... 48
Conventions
SCPI commands ... 76
Copying
Measurement channel (remote) ... 81
Coupling
Input (remote) ... 85
Crest factor
Input signal ... 23
CSV
File format ... 149

D

Data format
ASCII ... 147
Binary ... 147
Remote ... 124, 126, 127
Decimal separator
Trace export ... 48, 58, 69
Default values
Preset ... 24
Delta markers ... 61
Defining ... 60
Positioning (remote) ... 138
Diagram footer information ... 12
Discrete frequency transformation (DFT) ... 15
Display
Configuration ... 66
Information ... 10
Drop-out time
Trigger ... 41
Duplicating
Measurement channel (remote) ... 81

E

Electronic input attenuation ... 31
Error messages ... 74
Errors
IF OVLD ... 30
Evaluation
Methods ... 15
Evaluation methods
Remote ... 111
Export format
Measurement results ... 149
Traces ... 147
Exporting
Calibration data ... 68
Measurement results ... 68
Measurement settings ... 57
Trace data ... 68
Traces ... 57, 58, 69
Traces (remote) ... 125

External trigger
Level (remote) ... 97
Softkey ... 39

F

File format
CSV ... 149
Trace export ... 147
Filters
High-pass (remote) ... 85
High-pass (RF input) ... 28
YIG (remote) ... 85
Format
Data ... 147
Data (remote) ... 124, 126, 127
Free Run
Trigger (softkey) ... 39
Frequency
Configuration (remote) ... 93
Configuration (softkey) ... 36
Frequency offset ... 37

G

Gain
Definition ... 20
Evaluation method ... 18
Group delay
Absolute ... 21
Definition ... 20
Mode ... 46
Group Delay vs Frequency
Evaluation method ... 17

H

Hardware settings
Displayed ... 11
High-pass filter
Remote ... 85
RF input ... 28
Hold
Trace setting ... 55
Hysteresis
Lower (Auto level) ... 53
Trigger ... 41
Upper (Auto level) ... 52

I

I/Q Power
Trigger (softkey) ... 40
Trigger level (remote) ... 98
IF Power
Trigger (softkey) ... 40
Trigger level (remote) ... 98
Impedance
Remote ... 86
Setting ... 28
Importing
Calibration data ... 69
Input
Coupling ... 28
Coupling (remote) ... 85
Overload (remote) ... 85
Settings ... 27, 32
Source, Radio frequency (RF) ... 27
Source Configuration (softkey) ... 27
Installation ... 9

K

Keys
AUTO SET (not used) ... 24
LINES (not used) ... 24
MKR ... 58
MKR -> ... 63, 64
MKR FUNCT (not used) ... 24
Peak Search ... 65
RUN CONT ... 48
RUN SINGLE ... 48, 49

L

Linking
Markers ... 61, 62
Loading
Calibration data ... 48, 69
Lower Level Hysteresis
Softkey ... 53

M

Magnitude flatness
see Gain ... 20
Magnitude vs Frequency
Evaluation method ... 15, 16
Markers
Assigned trace ... 61
Basic settings ... 59
Configuration (remote control) ... 130
Configuration (softkey) ... 58, 59, 61
Deactivating ... 61
Delta markers ... 60
Fixed reference (remote control) ... 134
Linked ... 62
Linking ... 61
Minimum ... 65
Minimum (remote control) ... 135
Next minimum ... 65
Next minimum (remote control) ... 135
Next peak ... 65
Next peak (remote control) ... 135
Peak ... 65
Peak (remote control) ... 135
Position ... 60
Positioning ... 64
Positioning (remote) ... 136
Positioning (remote control) ... 130
Querying position (remote) ... 123
Retrieving results (remote) ... 122
State ... 60
Step size (remote control) ... 134
Table ... 62
Table (evaluation method) ... 18
Table (remote control) ... 134
Type ... 60
X-value ... 60
Marker table
Evaluation method ... 18
Marker to Trace
Softkey ... 61

Maximizing
Windows (remote) ... 110
MCGD
(Multi-Carrier Group Delay Application) ... 9
Configuring ... 24
Default values ... 24
Display ... 10
Settings ... 43
Starting ... 9
MC Group Delay
Absolute ... 13
Application ... 11
Measurement method ... 13
Measurement
Method ... 13
Method, orthogonal ... 21
Procedure ... 70
Remote control ... 75
Settings ... 43
Setup ... 13, 22
Time ... 21, 45
Time, Displayed ... 11
Measurement channel
Creating (remote) ... 81
Deleting (remote) ... 82
Duplicating (remote) ... 81
Querying (remote) ... 82
Renaming (remote) ... 83
Replacing (remote) ... 81
Measurement time
Auto settings ... 52
Min/max values
Y-axis ... 35
Minimum
Marker positioning ... 65
Next ... 65
Softkey ... 65
MKR
Key ... 58
MKR ->
Key ... 63, 64
Multi-carrier
Measurement ... 20
Multi-Carrier
Measurement method ... 13
Multi-carriers
Aligning with trace points ... 21
Offset ... 21, 46
Spacing ... 45
Multiple
Measurement channels ... 10
Multiple zoom ... 66

N

Next Minimum
Marker positioning ... 65
Softkey ... 65
Next Peak
Marker positioning ... 65
Softkey ... 65
Noise
Source ... 50

O

Offset
Frequency ... 37
Reference level ... 30
Options
Electronic attenuation (B25) ... 31
High-pass filter (B13) ... 28, 85
Preamplifier (B24) ... 32
Orthogonal
Measurement method ... 21
Orthogonal frequency transformation (OFT) ... 21
Output
Configuration (remote) ... 105
Configuration (softkey) ... 49
Noise source ... 50
Settings ... 49
Trigger ... 42, 50
Overload
RF input (remote) ... 85
Overview
Configuration ... 25

P

Peak excursion ... 64
Remote ... 135
Peak list
Peak excursion ... 64
Peaks
Marker positioning ... 65
Next ... 65
Softkey ... 65
Peak search
Key ... 65
Mode ... 63
Performing
Multi-Carrier Group Delay measurement ... 70
Phase
Unit ... 36
Phase vs Frequency
Evaluation method ... 16, 17
Preamplifier
Setting ... 32
Settings (remote) ... 89
Softkey ... 32
Presetting
Channels ... 26
Default values ... 24
Pre-trigger ... 41
Protection
RF input (remote) ... 85

Q

Quick Config
Traces ... 56

R

Range ... 34
Range per division
Y-axis ... 35
Reference level
Auto level ... 52
Displayed ... 11
Offset ... 30

Offset, displayed ... 11
Offset (softkey) ... 30
Position ... 34
Softkey ... 30
Unit ... 30
Value ... 30
Reference marker ... 61
Reference measurement
see Calibration ... 22
Reference position
Y-axis ... 35
Reference value
Y-axis ... 34
Remote commands ... 75
Basics on syntax ... 75
Basic tasks ... 75
Boolean values ... 79
Capitalization ... 76
Character data ... 79
Data blocks ... 80
Numeric values ... 78
Optional keywords ... 77
Parameters ... 78
Strings ... 80
Suffixes ... 77
Resetting
RF input protection ... 85
Restoring
Channel settings ... 26
Result displays
Gain ... 18
Group Delay vs Frequency ... 17
Magnitude vs Frequency ... 15, 16
Marker table ... 18
Phase vs Frequency ... 16, 17
Results
ASCII export format ... 147
CSV export format ... 149
Data format (remote) ... 124, 126, 127
Display ... 15
Exporting ... 57
Markers (remote) ... 122
Retrieving (remote) ... 122
Storing ... 15, 68
Traces, exporting (remote) ... 125
Traces (remote) ... 124
RF attenuation
Auto (softkey) ... 31
Manual (softkey) ... 31
RF input ... 27
Overload protection (remote) ... 85
Remote ... 84, 86
RF Power
Trigger ... 40
Trigger level (remote) ... 98
RUN CONT
Key ... 48
RUN SINGLE
Key ... 48, 49

S

Scaling
Configuration (Softkey) ... 32
Settings (remote) ... 90
Y-axis ... 34, 35
Y-axis (remote control) ... 93
Search Configuration (softkey) ... 63
Select Marker
Softkey ... 59, 64
Sequencer ... 10
Aborting (remote) ... 119
Activating (remote) ... 119
Mode (remote) ... 120
Remote ... 118
Signal generator ... 13
Measurement setup ... 22
Signal source
Remote ... 86
Single sweep
Softkey ... 48
Single zoom ... 66
Slope
Trigger ... 42, 99
Softkeys
Amplitude Config ... 29
Auto Level ... 52
Calibrate ... 47
Carrier spacing ... 45
Center ... 37, 44
Continue Single Sweep ... 49
Continuous Sweep ... 48
Display Config ... 66
External ... 39
Free Run ... 39
Frequency Config ... 36
Group delay ... 46
I/Q Power ... 40
IF Power ... 40
Input Source Config ... 27
Lower Level Hysteresis ... 53
Marker Config ... 58, 59, 61
Marker to Trace ... 61
Meastime Auto ... 45, 52
Meastime Manual ... 45, 52
Min ... 65
Multi-Carrier Config ... 43
Next Min ... 65
Next Peak ... 65
Norm/Delta ... 60
Outputs Config ... 49
Peak ... 65
Preamp ... 32
Ref Level ... 30
Ref Level Offset ... 30
RF Atten Auto ... 31
RF Atten Manual ... 31
RF Power ... 40
Scale Config ... 32
Search Config ... 63
Select Marker ... 59, 64
Single Sweep ... 48
Sweep count ... 45, 49
Trace 1/2/3/4 ... 57
Trace Config ... 54
Trigger Config ... 38
Trigger Offset ... 41
Upper Level Hysteresis ... 52
Span ... 37, 45
Definition ... 20
Displayed ... 11
Specifics for
Configuration ... 27

Status registers
STAT:QUES:POW ... 85
Step size
Markers (remote control) ... 134
Storing
Calibration data ... 47, 68
Measurement results ... 68
Suffixes
Common ... 80
Remote commands ... 77
Sweep
Aborting ... 48, 49
Count ... 21, 45, 49
Performing (remote) ... 116
Settings ... 48
Settings (remote) ... 116

T

Traces
Aligning carrier frequencies ... 21
Average mode ... 55
Averaging (remote control) ... 130
Configuration (Softkey) ... 54
Configuring (remote control) ... 127
Export format ... 48, 58, 69
Exporting ... 57, 58, 69
Exporting results (remote) ... 125
Hold ... 55
Mode ... 55
Mode (remote) ... 128
Retrieving results (remote) ... 124
Selecting ... 55
Settings, predefined ... 56
Settings (remote control) ... 127
Softkeys ... 57
Trigger
Conditions (remote) ... 96
Configuration (softkey) ... 38
Drop-out time ... 41
External (remote) ... 99
Holdoff ... 41
Hysteresis ... 41
Level ... 41
Offset (softkey) ... 41
Output ... 42, 50
Remote control ... 95
Slope ... 42, 99
Trigger level
External trigger (remote) ... 97
I/Q Power (remote) ... 98
IF Power (remote) ... 98
RF Power (remote) ... 98
Trigger source ... 39
External ... 39
Free Run ... 39
I/Q Power ... 40
IF Power ... 40
RF Power ... 40
Troubleshooting ... 73
Input overload ... 85

U

Units ... 35
Reference level ... 30
Settings (remote) ... 90
Upper Level Hysteresis
Softkey ... 52
User manuals ... 6

W

Windows
Adding (remote) ... 111
Closing (remote) ... 113
Configuring ... 27
Layout (remote) ... 113
Maximizing (remote) ... 110
Querying (remote) ... 112
Replacing (remote) ... 113
Splitting (remote) ... 110
Types (remote) ... 111
Window title bar information ... 12

X

X-value
Marker ... 60

Y

Y-axis
Mix, max values ... 35
Range per division ... 35
Reference position ... 35
Reference value ... 34
Scaling ... 34, 35
Settings ... 32
YIG-preselector
Activating/Deactivating ... 28
Activating/Deactivating (remote) ... 85

Z

Zooming
Activating (remote) ... 140
Area (Multiple mode, remote) ... 140
Area (remote) ... 139
Deactivating ... 67
Multiple mode ... 66
Multiple mode (remote) ... 140, 141
Remote ... 139
Restoring original display ... 67
Single mode ... 66
Single mode (remote) ... 139